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APPLICATIONS FOR MICROGRAPHICS IN LARGE SCALE INFORMATION SYSTEMS OF THE FUTURE. VOLUME I: PART I. SUMMARY. PART II. FIVE-YEAR PLAN FOR DDC MICROGRAPHIC DEVELOPMENT ACTIONS

Information Dynamics Corporation
Reading, Massachusetts

August 1966

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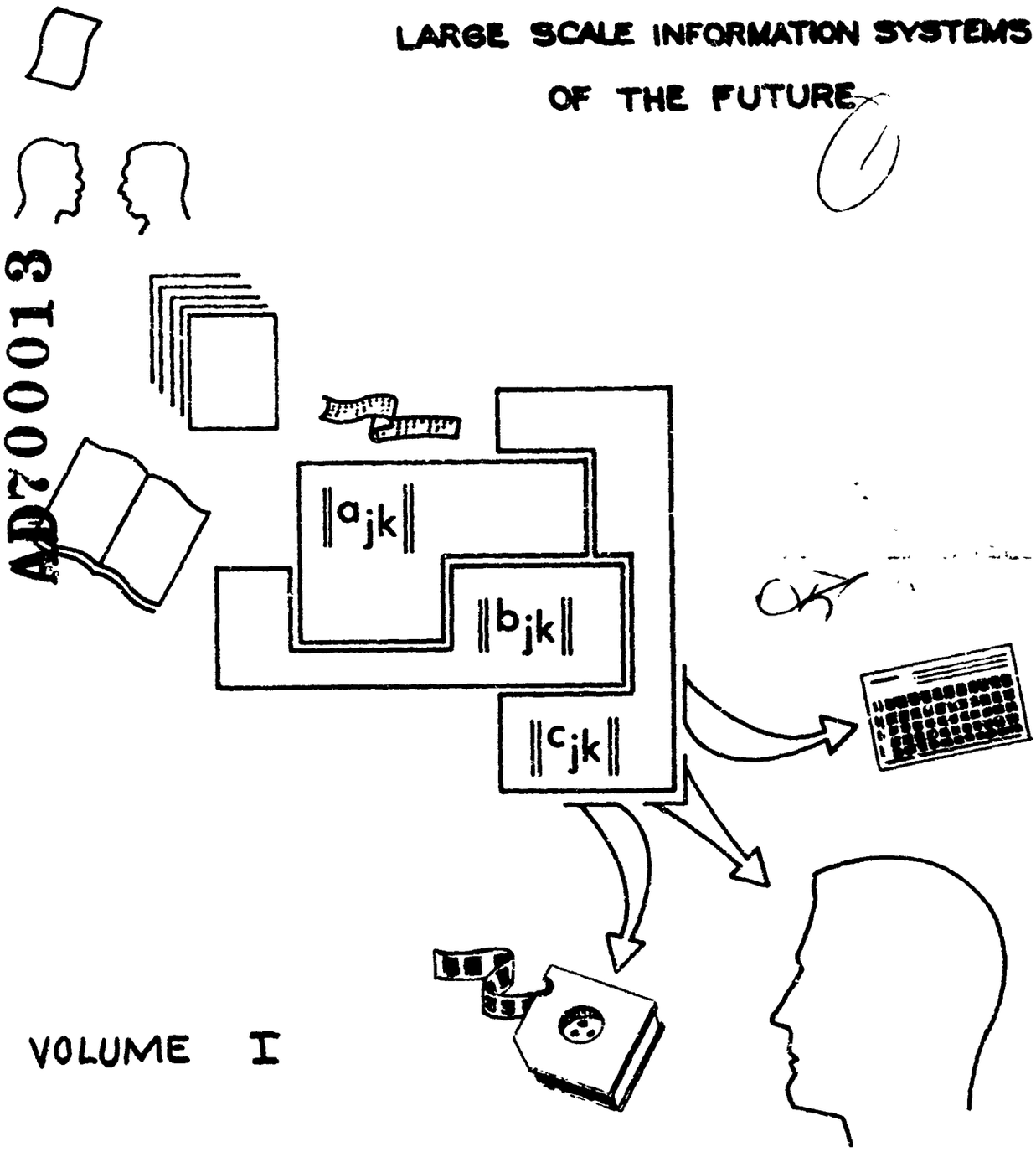
APPLICATIONS FOR MICROGRAPHICS IN LARGE SCALE INFORMATION SYSTEMS OF THE FUTURE



VOLUME I

A 5-YEAR DEVELOPMENT PROGRAM PLAN FOR THE DEFENSE DOCUMENTATION CENTER

INFORMATION DYNAMICS CORPORATION

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APPLICATIONS FOR MICROGRAPHICS IN LARGE SCALE INFORMATION SYSTEMS OF THE FUTURE

A 5-Year Development Program Plan
For the Defense Documentation Center

PART I

Summary

PART II

The Recommended Development Program -- 5-Year Plan

August 1966

Prepared for

Defense Documentation Center
Cameron Station, Virginia

by

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FOREWORD

This report, prepared under Contract DSA-600-12300 for the Defense Documentation Center, is presented in three parts:

Part I - Summary

Part II - Five-Year Plan for DDC Micrographic Development Actions

Part III - A State-of-the-Art Review

Parts I and II appear in Volume One, and Part III appears separately as a second volume due to the confidential nature of its contents. Several manufacturers of materials and microfiche handling equipment have disclosed their advanced thinking and product plans for use in this report - under the explicit understanding that these plans would not be widely announced.

The first volume of the report contains a summary of the plan as well as the major findings, conclusions and recommendations developed during the course of the study. The results of the research and analysis of the objectives and goals of DDC operations are reviewed. Specific service concepts, beyond those now present, which appear responsive to basic DOD/RDT&E needs for Scientific and Technical Information (STINFO) are identified. A technique is developed and used to display the individual data and information items and process steps involved in providing these STINFO services. The applicability of using micrographic media is examined and alternative plans are synthesized for developing DDC capabilities that can exploit present and new service concepts through use of micrographics. The alternative plans presented are described in terms of specific DDC development actions that are required to achieve the desired capabilities. Finally, the impact of these alternative plans is analyzed and presented.

Volume Two contains the results of the State-of-the-Art Review conducted to ensure current awareness of the equipment, materials, methods and techniques available for handling microfiche. The review was extended to include advanced development programs now underway and was aimed partially to allow a forecasting of the life expectancy of widespread use of the microfiche format now described in standards established by the Federal Council on Science and Technology.

The IDC team effort on this study began mid-May 1966, with a time limit of three months to complete the research, analysis, and development of the five-year plan for microfiche development actions. As a result of the short time available, the study team has undoubtedly fallen short of a full acquaintance with future plans and programs for development of STINFO service systems in DOD. Other than the present DDC services, plus those paraphrased as "RFP packages" and "SDI of microfiche," the projected service concepts that are included in the alternative plans presented are without official endorsement. The license to include hypothesized new service concepts was implied in the central work statement which referenced "potential missions," "changes in functions" and "potential products/services." Although the study team is experienced and competent, its suggestions for additional services cannot be considered a satisfactory substitute for a much-needed definitive policy statement concerning future service concepts to meet RDT&E scientific and technical information needs. The future services hypothesized provide, however, definitive development action plans that are responsive to reasonable service goals. Their consideration and evaluation in terms of their impact on future DDC operations is revealing.

The study does not concern itself with development of DDC production plant design in detail. It does evaluate the capabilities of the present production system. The plan developed extends from this baseline identifying those development actions that are required to achieve capabilities through the next five years for exploiting microfiche for what appear to many to be desirable service concepts.

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Part II

A. OBJECTIVES OF THE STUDY

This report contains the results of a planning effort intended to provide the Defense Documentation Center with a five-year plan (FY 1968 - 1972) for the development of improved and new microfiche products, services and production capabilities. The resultant plans contained herein present a detailed, time-phased program of development actions responsive to the needs for presently recognized and future possible service concepts. The plans can be implemented on an evolutionary basis starting with the existing DDC capabilities.

1. PRIMARY OBJECTIVES

The study had several major objectives: (1) to define objectives and goals of DDC systems plans in terms of specific information products, services, capabilities and performance levels, (2) to identify projected production system needs, (3) to assess the efficiency of present DDC microfiche operations in relationship to present DDC missions and user needs, (4) to assess the present state-of-the-art of microfiche equipment, processes and handling techniques useful to DDC operations, and (5) to synthesize development action plans required by DDC to accomplish the future capabilities required over the five-year period and beyond.

It was observed (under a former contract) in an analysis of the previous DDC five-year (FY 1967 - FY 1971) development plan, that recent five-year plans have been concerned primarily with improvements of present internal operations. In short, a past deficiency appears to have been over-emphasis on development of plans from the bottom up (existing activities) rather than the top down (overall objectives), thereby subordinating a perspective now needed to assure satisfactory interfacing with external Federal system developments and new DOD Scientific and Technical Information (STINFO) service concepts.

In the present study, the intent was to provide a realistic basis upon which to develop and operate an expanded DDC system that would be responsive to both present and potential missions, workloads, and development programs, as well as future possible changes to organization, functions, resource levels, and allocations.

2. SECONDARY OBJECTIVE

Recognizing that long range plans rapidly become obsolete as overall objectives, goals, policies, technology and other environmental factors shift, an important secondary objective was to develop a planning method that would provide a penetrating and effective way to accommodate these inevitable changes with a minimum of rework necessary to maintain utility of the five-year plan.

B. APPROACH AND MAJOR ASSUMPTIONS

1. APPROACH

The approach used to develop the DDC five-year plan for micrographic development actions can be outlined as follows:

(a) After an initial analysis and review of present DDC missions, an extensive effort was made to survey present DDC micrographic (and related) capabilities to provide the basis for an evaluation and assessment of the existing baseline from which to build future capabilities.

(b) A review was made of current and past DOD-sponsored and DOD-related studies of scientific and technical information services in an effort to comprehend the direction of objectives and goals of service activities for RDT&E and related user communities. Large-scale STINFO service system concepts were reviewed to permit identification of those future concepts likely to be considered as candidates for DDC production requirements.

(c) New service concepts were then identified in addition to those now provided. Present and future data and information (D&I) items constituent to these services were identified.

(d) The Process activities through which the D&I items of each service pass (i.e., receipt, scanning, microfilming, storing, etc., of technical reports) were also identified in order that a specific determination could be made concerning the applicability of micrographic media in future DDC operations.

(e) Through the assistance of a State-of-the-Art Review conducted in parallel with this planning study (Part III), a current appraisal of both technical and economic feasibility of further use of micrographic techniques was made. The analytic method employed provided the basis for a penetrating analysis that identified specific development actions necessary for DDC to undertake in the event that the application is included in future plans.

(f) Attention was then turned to scoring and ranking the desirability of the suggested service concepts. This resulted in the definition of five specific alternative, composite plans that include projected service concepts that have been suggested or considered for DDC's adoption.

(g) Specific development actions were then described in terms of equipment, materials, methods, and procedures plus advanced development and exploratory studies as required to achieve future production capabilities. These established the basis for projecting required resources, both manpower and budget.

(h) Finally, the impact of adopting any of the alternative plans was analysed to show just what the future would hold for DDC if missions and workloads were broadened in accordance with the projected plans.

In certain critical detailed steps of both analysis and synthesis, matrix displays were used to allow the handling of a great amount of detail in a highly organized way. This provides a path for retracing choices made during the course of study and enables modifications and future maintenance of the plan as changes in various elements occur.

The study begins with a full-scope consideration of micrographics and narrows to specific selections of both microfiche and cartridge roll film. Consideration of the use of these micrographics extends to source-production community activities--before materials arrive at DDC-- as well as activities of user communities that receive products and services from DDC and other RDT&E STINFO service supplies.

The philosophy behind the choices for suggested new service concepts emphasizes the desire to further exploit, through greater use with minimum additional expense, the data base and system facilities now available to DDC. Recognition is made of the possibility that much larger scale information processing activities may fall to DDC in the future. These possibilities are considered in alternative plans presented in order to indicate the magnitude of their impact, should this occur.

2. MAJOR ASSUMPTIONS

The following major assumptions were made as underlying foundations of the study:

(a) DDC's Roles and missions will continue to include services to the scientific and technical community with documentation services provided in parallel and without diminution along with the newly assigned primary mission to maintain and operate the Work Unit R&D Management Information System.

(b) DDC can be expected to grow into areas of increasing responsibility as STINFO service networks develop for DOD that require centralized processing functions relating either to document services or management information systems.

(c) Any new large-scale systems for providing STINFO services will be evolutionary in character, starting with the present systems and evolving into forms consistent with overall plans communicated in advance to allow build-up of the necessary capabilities to carry any newly assigned responsibilities for DDC.

(d) The effect of national document handling system planning must be taken into account within the next five years in future planning, but will not be likely to effect operating activities until near the end or beyond the five-year (FY 1967 - 1971) period.

(e) DDC has responsibility for introduction of new service concepts and implementation of their production within the limits of presently assigned missions and policy.

(f) This study requires development of alternative plans from which to choose a set of development actions to expand micrographic capabilities within time, manpower, and fiscal budget limitations.

(g) It is important that a planning methodology be developed that is responsive to management objectives, programs, and specific service concepts. Further, the plan should accommodate any kind of information service requirement, both from DDC's production point of view, as well as user needs, without limitations regarding assumptions (b) and (d) above.

C. END RESULTS ACHIEVED

This section summarizes the several results achieved from the analysis and synthesis work done in developing the five-year plan. The summary is presented below in the sequence of the study objectives outlined in Section A.

1. Regarding Objectives and Goals of DDC Systems Plans

Objectives and goals for DDC systems plans were defined as a result of analysis of past and present DOD sponsored STINFO service system studies. To the degree that these studies have evolved concepts consistent with DDC's mission, these were used to identify new service concepts, including:

(a) Periodic annual distribution of full announcement journals and indexes to TAB on cartridge roll film.

(b) On-demand distribution of state-of-the-art sets of full-text reports (as selected by Information Analysis Centers) on microfiche.

(c) Automatic distribution service of task-related technical reports on microfiche to active project teams as defined by 1498 reports.

(d) Acceptance by DDC of microfiche masters to be produced by contractors and DOD source-producers of technical reports.

(e) Assembly of technical report sets (as related to procurement action) in microfiche form for distribution as parts of RFP packages.

(f) Distribution of research-in-progress hard-copy indexes for use by scientific and technical personnel.

(g) Distribution of index listings and maintenance of centralized registry of "Contractor Technical & Production Capabilities."

(h) On-demand computer-produced management reports from contractor performance evaluation and contractor cost reduction data banks.

(i) Distribution of one of several forms of truncated technical reports (study recommended).

(j) Maintenance of inventory listing of all vital technical information including engineering data and other items as well as technical reports (study recommended).

(k) Distribution of engineering data, and items other than technical reports (study recommended).

(l) Centralized maintenance of primary and secondary distribution (e.g., mail addresses) records along with support material handling functions.

Other service concepts were identified, evaluated, and rejected. However, these are included in the report for comparison purposes.

Both present and projected service concepts were described in specific terms of product design as to use of microfiche and/or other micrographic record form. Projected loads were used to identify required capabilities.

The entire plan, in contrast to prior five-year plans, has been developed using selected service system concepts as starting points.

2. Regarding Projected Production System Needs

Analytic projections of flow rates relating to present service activities of DDC were made and used as the baseline for projecting future requirements. Production system needs to accommodate the new service concepts were added, and a set of alternative plans structured that are responsive to production system needs resulting from each of the enumerated plans.

The need for a plant-wide integrated process control system was identified. Specific tasks were then described as needed to construct an extended production system to continue present services and to accommodate new services if adopted.

3. Regarding Evaluation of Present DDC Microfiche Operations

Present microfiche operations at DDC were found in a status of reorganization, thereby accounting in part for the lack of written operating instructions for personnel. Areas of main deficiency were those of microfiche camera operations (considered experimental) and unenforced quality control steps that are necessary to accomplish consistently satisfactory microfiche production results. The total facility being assembled is adequate to meet present workloads for duplication of microfiche, but cannot at present provide the necessary capability for producing offset plates for press runoff from blowback images recorded in microfiche form.

Although equipment difficulties currently hamper operations of the experimental DDC microfiche facility, it is serving to train personnel in production operations that must very soon develop into a smoothly working capability to produce the volume of microfiche duplication and distribution expected from new service operations (e.g., RFP packages and distribution of subject sets to major users).

4. Regarding Present State-of-the-Art of Micrographics

Results of the parallel review of state-of-the-art of microfiche and related micrographic equipment processes and handling techniques are presented in Part III.

In summary, it can be concluded that the microfilm industry has moved quickly to exploit the market resulting from the standardization established by the Federal Council on Science and Technology. There is little basis for expecting the clustering of interests around the 4 by 6 microfiche (at a reduction ratio of nearly 20 to 1) to dissipate until a time beyond the FY 1967 - FY 1971. Cost reductions in production of microfiche of over 50 percent are expected within this time period through use of direct imprint methods, thereby adding a further stabilizing influence to continued use of the present standard (or approximated facsimile).

Cartridge roll film, more useful to certain information service products such as cumulative TAB indexes and abstracts listed by AD number, can be made compatible with microfiche viewing and blowback equipment designed for field use.

5. Development Action Plans Synthesized

Detailed development action plans have been synthesized and presented in Section F, Part II. Impact of the detailed actions is summarized in Section G.

The plans have been presented on the basis that the present services will continue and extend over the next five years. This is considered the baseline requirement and is referred to as "Plan Zero." Plan Zero includes specific development actions to begin conversion of present plant operations to a plant-wide integrated process control system approach.

As additional service concepts are added, Plans 1, 2, 3 and 4 are offered as alternatives. In addition to the continuation of present services, the alternative plans are characterized as including the following:

(a) Plan 1 includes:

(1) Assembly of RFP technical report package sets on microfiche.

(2) Distribution of research-in-progress hard-copy indexes.

(3) A study of requirements to assemble and maintain a comprehensive inventory listing of all technical information and data in addition to technical reports.

(b) Plan 2 includes:

(1) Distribution of index listings and maintenance of centralized registry of "Contractor Technical & Production Capabilities."

(2) Automatic distribution service of technical reports on microfiche to task-oriented project teams.

(3) Periodic annual distribution of full announcement journals and TAB Indexes on cartridge roll film

(4) Study to determine feasibility of DDC's distributing technical information other than technical reports.

(c) Plan 3 includes:

(1) On-demand distribution of state-of-the-art full-text technical report sets in microfiche form.

(2) On-demand computer-produced management reports from contractor performance evaluation and contractor cost reduction data banks.

(3) Distribution of one of several forms of truncated technical reports in micrographic form to curtail "exploratory" request for hard copy.

(4) Exploratory study of the feasibility of operating a centralized primary distribution record maintenance and material handling support function at DDC.

(d) Plan 4 includes:

(1) An exploratory study of the feasibility of segmenting announcement journals by subject field and distributing them for distribution in both hard-copy and micrographic form.

(2) An advanced development study of methodology for permitting DOD contractors to supply technical reports in microfiche master form.

(3) An exploratory study of the feasibility of DOD's controlling technical report structure to prescribed formats thereby allowing subsequent demand distribution of segmented portions in hard copy.

The plans presented are progressively cumulative. That is, Plan 1 includes Plan Zero; Plan 2 includes Plan Zero and Plan 1; Plan 3 includes Plan Zero, Plan 1 and Plan 2; etc.

The development actions associated with each plan are similar but have been restructured to optimize their execution within the specifications of the specific plan chosen.

All plans developed derive from initial definitions of service concepts and the capabilities required to provide them.

6. Regarding Development of a Planning Methodology

The methodology developed for the derivation of the DDC five-year plan to extend micrographic capabilities is a general purpose technique. It starts with identification of specific service concepts, and moves on to identify specific data and information items and the process steps through which they flow. The handling of a great amount of detail is facilitated through the use of matrix displays which permit identification of areas for future application of micrographic media. From these displays and a knowledge of the state-of-the-art, the new technology required to carry out future capabilities can be readily identified. The methodology further utilizes a scoring method for rating desirability of new system concepts and employs this to evolve alternative plans for selection according to DDC's desire and budget limitations.

The individual plans are subdivided into development actions. These are identified by the manpower and fiscal requirements needed to carry out each resulting in a method that is completely flexible for identifying the elements of cost in any particular plan chosen for implementation.

D. CONCLUSIONS

Conclusions drawn from the research, analysis and planning synthesis work in this study are summarized according to (1) DDC's present capabilities, (2) the direction of future DDC missions, (3) direction and impact of future STINFO service concepts, (4) future direction of micrographics as used in large-scale STINFO service systems, and (5) future impact of the five-year plan presented.

1. PRESENT DDC MICROFICHE CAPABILITIES

Specifically in the area of production capabilities for microfiche, DDC has assembled the necessary facilities for meeting immediate workloads. Areas of deficiency identified in operating procedures were limited to: present error rate of experimental camera installations, incomplete material-handling procedures for optimizing camera operator performance, problems remaining in control of physical dimension of microfiche duplicates, the lack of a satisfactory lithographic mat-producing step-and-repeat device to work from microfiche, and failure to actually implement necessary quality control procedures to achieve adequate end-product quality in microfiche production. All of these problems are solvable if given proper attention.

The present facilities provide only the beginnings of the capability needed for handling future projected micrographic requirements. Microfilm camera workloads are not expected to grow beyond 10 percent per year, but all subsequent operations of microfiche retrieval from file (masters), quantity duplication, and repetitive blow-back for producing offset masters, will completely overload the present capabilities. The facility, as it stands, provides a training ground and introduction to the production operations, which shortly must be greatly reinforced to handle the projected workload. Details of the five-year plans presented herein identify the steps necessary to accomplish this objective.

Due to the increasing pace of the introduction of new equipment, materials, and techniques for the application of micrographics to information handling systems, DDC should establish an internal capability to test and evaluate significant additions to the field that have potential applicability to DDC process activities. It would also be appropriate for this group to maintain a running evaluation of the process activities and, in particular, the material handling problems, both of user communities receiving micrographic products supplied by DDC and the present source producers of technical reports as well as other engineering data documents. DDC should maintain an awareness of availability and technical expertise covering the full scope of micrographics as used in STINFO service systems.

2. DIRECTION OF FUTURE DDC MISSIONS AND WORKLOADS

The studies and preliminary systems design work in STINFO service areas sponsored by DOD, though not expected to become operational immediately, will, within the next two years, likely precipitate definite plans to develop large-scale STINFO service and/or systems networks. Regardless of the several alternative directions such networks might take, several functional operations will best be served by a centralized production facility, such as that now operated by DDC. It is concluded, therefore, that the future holds promise of substantially increasing volume both in kind and quantity for information and document handling at DDC.

DDC will need the earliest possible clarification from higher authority of new mission assignments in order to adequately develop capabilities required to meet increasing production requirements.

Information processing activities in support of management information services have recently been emphasized. An increase in the scope and dimension of new services, is expected to utilize further the contents of both management data banks and the technical report stores.

The interfaces of flow in scientific and technical information between DOD and the non-DOD communities of the Federal government are likely to become more active, stronger, and more purposeful, although the existence of an operating "Federal Information System" is unlikely within the five-year period. Because of its centralized and established position, DDC is a prime candidate to maintain the primary interface activities between DOD and non-DOD communities.

3. THE DIRECTION AND IMPACT OF FUTURE STINFO SERVICE CONCEPTS

Major studies concerned with identification of user needs for technical information and engineering data services are not, as yet, completed and cannot be expected to provide precise service specifications to suppliers. Conclusions emerging from these studies, however, do show very significant areas of information service needs over and beyond the technical report document handling functions as concentrated in DDC. Extensive use of engineering data and the need for comprehensive bibliographic control (i.e., inventory listing) of much larger stores of information resources used by the RDT&E community, are two significant areas likely to provide the thrust for implementing new service concepts.

It appears feasible, and of definite value, to identify new services which DDC can provide to both management and working scientist communities by combining existing technical report stores, there established relationship with the Information Analysis Centers, and DDC's new primary mission of maintaining the work unit R&D management information data banks. The latter can be considered as providing "bibliographic access to the user community."

Technological change will continue to bring primary and secondary distribution concepts closer together. Centralized maintenance of records necessary to carry out primary distribution, including mailing address lists, security records, etc., auger for centralization. Elimination of intermediate time delays effecting delivery of services to users is an important objective warranting the introduction of methods for bypassing the present series of lags in the transfer chain from source to user.

The policy of providing no-charge services to DOD contractors prevents the exercise of self-regulating forces which would greatly improve DDC's ability to control and forecast the extent of its operations as new service concepts are introduced. Without some effective means of self-regulation, policies to curtail runaway use may have to be employed. Arbitrary restrictions would probably result in less responsive and more deleterious effects on service convenience to widespread contractor-user communities.

4. FUTURE DIRECTION OF MICROGRAPHICS AS USED IN LARGE-SCALE STINFO SERVICE PROGRAMS.

Micrographics directly attack the central problem of material handling inherent in providing document services. There is no basis for expecting technological development of either communication techniques or electronic storage media to replace micrographic media as the primary means for transferring the bulk of technical data and information from source to user.

Manufacturers and suppliers in the micrographic field are now just introducing new products made feasible by the microfiche standards of the Federal Council on Science and Technology. Private investments in general-purpose new product development without the need for Government support are mounting due to expectation of an extended commercial use of the microfiche format. Specialized material handling problems, such as those present at DDC (sorting, collating, stuffing, wrapping, labeling) await action by needing solution to their problems to support specialized

equipment exists. Although R&D capabilities demonstrate the technical feasibility of higher reduction ratio micrographics, the investments recently made by the microfilm industry in microfiche related products mitigates against early conversion of the field to higher reduction ratios.

New service concepts (e.g., micrographic annual accumulations of TAB) are preferably provided to libraries on cartridge roll film. Cartridge roll film and microfiche microforms are readily integrated in user equipment, thereby requiring only a single investment in viewing and blow-back equipment. This appears to be an early natural development to take place in the field.

Perhaps one or two years away, another significant impact in micrographics is expected. This is the production of transparencies by high-speed, repetitive imprint by press-like methods. This will cut the present high-volume duplicating costs more than 50 percent, with resultant trends to increase micrographic media use in source publications. If achieved within the next five years, this low-cost replication of micrographics will probably stabilize the reduction ratio to no greater than 20:1, thereby prolonging the future adoption of higher reduction ratios for widespread use.

5. FUTURE IMPACT OF FIVE-YEAR PLANS DEVELOPED FOR DDC

The implementation of the action plans described here will continue the evolution of DDC toward serving the entire R&D and I&L communities, and improving the flow between them. This should result in better program management capability with the consequent reduction in the time consumed in the entire cycle.

Many facets of the plans relate to direct service to the scientists and engineers in the RDT&E community. Depending on the success of some of the proposed studies dealing with furnishing information with great specificity to respond to particular needs, it should be possible to improve the efficiency of R&D to a significant extent.

The proposed changes in methods of production suggested as a basic requirement underlying all the plans can greatly improve the overall posture of DDC in the DOD community and establish its position as a strong force in the evolution of a total information system in DOD, and a significant consideration in the evolution of Federal systems as well.

The suggested plans call for more and more emphasis on services in the management information area. These are very significant, for they have large positive impact values on both the management and the conduct of R&D. They all promote increased quality of work and reduced costs.

E. RECOMMENDATIONS

1. Remedial actions to correct present deficiencies in microfiche production facilities have been detailed in Part II, Section C. These relate to developing material handling procedures at camera work places, introduction of camera malfunction detectors, and enforced use of quality control procedures throughout the microfiche area.

   Upon completion of reorganization of the facilities (underway during this study), clean, tidy, and efficient work place arrangements should be established and maintained. Written operating procedures should be developed as standard operating procedures.

2. The projected five-year plan for micrographic development actions contained in Part II of this report should first be integrated with other components of the five-year plan being developed in the ADP and related areas.

3. A preliminary systems design should be started to accomplish plant-wide integrated process control. This preliminary design should then be used to guide in detail the direction of interim development actions taken. Preliminary design should ultimately lead to a final design for implementation of integrated process controls.

4. DDC should establish an on-going internal group, or contractor relationship, to maintain an on-going evaluation of developments in the micrographic field as they apply to process activities and to overall STINFO service system requirements. This group should continuously evaluate developments to determine their applicability and potential value for meeting DOD-wide system requirements, as well as those for DDC.

5. Implement the plan or plans, as approved, that are developed and presented herein for expanding DDC's micrographic capabilities. Development actions, presented in detail in Part II, include both advanced development and exploratory development studies necessary to direct future plan implementation. Several development actions are sufficiently basic at the present time to justify initiation of experimental pilot operations and evaluation tests.

6. Continuously maintain projected long-range plans, using the methodology developed and presented herein, in order to permit downward derivation of program goals and development action plans

from overall mission objectives and service concepts that are responsive to user requirements.

7. Additional areas recommended for further work, but not specifically included as development actions described in the projected five-year plan, are:

   (a) Development of a methodology for better maintenance and projections of workloads at DDC.

   (b) Investigation of the feasibility of dropping or modifying the no-charge policy to contractors for DDC's services, in order that the self-regulating forces will provide a natural, rather than arbitrary, constraint against the possibility of excessive operating expense as services grow.

PART II

A. INTRODUCTION

1. THE NEED FOR DEFINITIVE FUTURE PLANS

Planning of future DDC operations is necessary if chosen goals are to be reached. Planning is essential in order for any organization to have time available to achieve orderly efficient progress, to avoid expensive false starts in production, and to acquire a posture of readiness to meet future service system requirements.

Effective planning requires analysis and research plus imaginative and creative thinking on the part of the planners regarding:

(a) The objectives which they are working towards and which have been established by higher authority.

(b) The policies which they are working within and which have been established by higher authority.

(c) The forecasts, estimates, plans, programs, schedules and budgets for personnel, equipment, facilities and materials which they are establishing, including the correlation with the needs and objectives of other component activities and of the organization as a whole.

Successful planning is based on maximizing the choice of alternatives to achieve stated goals. Any plan will become obsolete when either goals change or the alternative chosen becomes less desirable than new ones made possible (e.g., through changes in technology).

The foregoing basic observations would apply to any organization. The Defense Documentation Center is no exception in their need for clear objectives supplemented by specific yet flexible plans to achieve stated goals approved by higher authority. At the present time both the fields of documentation and information processing technology are undergoing significant changes. Document handling activities, once nearly unique at ASTIA, are now carried out on a large scale by several interacting Federal agencies moving toward network-like operations. DDC has, by both mission and history, been cast as a major constituent part of Federal programs to participate in the development of stronger, more effective large scale Federal Document Handling Systems for serving national needs, especially in scientific and technical research and development programs.

What should the future capabilities of DDC be? What specifically are the steps that should be followed to develop these capabilities? What degree of choice amongst alternatives is available? What are the resources required to attain specific levels of capability? These are some of the major questions considered in this study. Although the main concern of this report is specifically the development of a five-year plan for advancing DDC's capability to utilize and handle micrographics, the scope of the study necessarily embraces questions of objectives, roles and missions, policies, forecasts, estimates, plans, programs, and schedules of the entire operations, for without such a reference frame no valid plans can be developed.

ELEMENTS OF PLANNING ARE CONSTANTLY CHANGING

Like the weather, the elements considered in long range plans are individually dynamic. DDC service requirements will change considerably during the next five years from what they are now expected to be. The volume of material to be handled will change. The state-of-the-art in micrographics and related technology useful to carrying out the production process will change. Even the governing policies, if not objectives for DDC as established by higher organizational authority, may significantly change in the next five years.

It is futile, however, to attempt to predict the future. The only effective way to proceed with development of a five-year plan for DDC is to anticipate future effects of events that have already irrevocably happened and to undertake actions which will cause future events to reinforce the likelihood of achieving desired goals.

A basic requirement in performing this planning study was the development of an effective methodology for the analysis, display, and maintenance of a detailed plan for building service capabilities and the necessary development actions to achieve them. The scope of alternative service concepts, variety of data and information items, and process activities involved makes this an unusual challenge.

The specific plan presented in this report is the result of both analysis and research of what is now known about DDC operations and missions plus the objectives and policies within which DDC operates. Some license has been taken, hypothesizing future possible changes in policy and objectives for DDC. Part of the plans resulting from these hypotheses must be recognized as based on suppositions and carefully reviewed for validity.

3. METHODOLOGY USED TO DEVELOP THE FIVE-YEAR DEVELOPMENT ACTION PLAN FOR MICROGRAPHICS

Analysis is the first step to successful synthesis. To understand an organism too complex to analyze in the whole requires a breaking of the whole into parts. After examining how the parts work and how the parts fit together, plans for making the parts work and fit together better can be made valid, comprehensive, and penetrating. An in-depth technical understanding of the buildup of the plan not only assures thoroughness but facilitates a determination of the impact of the plan and its implications.

The methodology used for analysis and synthesis of the plan can be outlined as follows:

(a) The objectives and policies established by higher authority plus those which can be logically deduced from an understanding of the RDT&E requirements for STINFO services are first studied. These are then stated as assumptions in order that overall system requirements for STINFO services effecting DDC can be defined and related to DOD's need for production capabilities to handle micrographics.

(b) In response to RDT&E STINFO service requirements, a set of additional service concepts are identified that appear to be candidates for either further study or early adoption. New services, combined with projections for those now being offered, provide the working objectives around which the five-year plan is developed.

(c) Recognizing that DDC's present production facilities represent a base line of capability from which to build for future operations, a detailed analysis of DDC present production capabilities for handling micrographics has been made. An evaluation is then made of these capabilities related to alternative methods and procedures for accomplishing present goals and as a starting point for building future capabilities.

(d) A long range forecast of the technical feasibility of utilizing micrographic media for handling document and information services in large scale scientific and technical information service systems is made. A strong basis is demonstrated for expecting a continuing long period of use of micrographic media.

(e) Associated with each of the service goals incorporated in the projected plans is a specific set of physical products or data and information items. These items flow through a series of production process steps threading from original source to user. Matrix displays are used at this point to enable a detailed analysis of the many potential applications of micrographics. The level of analysis approaches that of production work places in terms of equipment, materials and methods necessary to perform the process steps.

(f) Examination of these potential applications in the light of available state-of-the-art in micrographics then allows determination of whether or not new technology is needed to achieve a specific micrographic handling capability, if it is used to provide a desired service.

(g) Rating the services concepts according to their desirability (payoff and feasibility) then provides the basis for structuring a set of alternative plans, each of which offers and identifies specific development actions as necessary to achieve the capability of handling those micrographics necessary to provide stated services.

Use of this methodology provides full communication of the underlying decisions on which the alternate plans are built. The job of retracing in order to make revisions due to change in judgment, governing conditions, etc., is relatively simple.

4. THE NEED FOR KEEPING PLANS CURRENT AND RESPONSIVE TO CHANGING EVENTS

The management philosophy and observations of paragraph one above has not been stated as a justification for planning. It is a state-

ment of the need for planning. Adequate planning efforts should be undertaken to achieve a posture at DDC that will respond to future requirements in scientific and technical information services as needed to meet requirements of the RTD&E community. It is believed that this report provides a methodology especially well suited to both development and maintenance of these plans.

B. DDC REQUIREMENTS FOR HANDLING RECORD MEDIA WITHIN DOD STINFO COMMUNICATION SYSTEMS

1. HISTORY OF THE GROWTH AND ASSIGNMENT OF RESPONSIBILITY TO DDC

1.1 Historical Development

The Defense Documentation Center (DDC) was not created; it evolved over a period of four decades, outgrew two facilities, and underwent four organizational changes. The history of DDC can best be understood by tracing these changes and by noting the milestones reached along the way, including the absorption of large document collections.

1.1.1 U. S. Army Air Corps, Engineering News Service

In 1926 two men in the U. S. Army Air Corps started an Engineering News Service at McCook Field in Dayton, Ohio. To keep their fellow engineers informed of the latest engineering developments, these men published an announcement bulletin which listed the titles and authors of the current military engineering literature. This bulletin was the forerunner of the present DDC Technical Abstract Bulletin. The Engineering News Service was moved to Wright Field in 1929 to a facility which later housed the organization from which DDC evolved.

1.1.2 Air Documents Division, U. S. Army Air Corps

During World War II, the Engineering News Service was incorporated into the Intelligence Department of the Air Technical Service, U. S. Army Air Corps. The Air Documents Division (ADD) of the Intelligence Department, established in December 1945, was responsible for the collection and analysis of over 800,000 captured German and Japanese documents. These documents had been collected by a specially created intelligence operation known as the Air Document Research Office based at Hanau, Germany, in July of 1945. Parts of this very large document collection later formed the nucleus of the present DDC collection.

1.1.3 Central Air Documents Office

In September of 1947, the United States Air Force was created as an entity separate from the Army. The ADD continued its operations in the new Department of the Air Force until October of 1948. Shortly after the separation of Army and Air Force, ADD absorbed a Navy liaison office which had been established at Wright Field in 1945.

In October, 1948, the functions of ADD were transferred to a newly created organization - the Central Air Documents Office (CADO) - under a joint Air Force/Navy venture. In 1950 the Army joined in the agreement to operate CADO, and an Army officer was assigned as one of the assistant directors.

CADO eventually had a collection of over 250,000 documents, including those absorbed from the ADD. In its last year CADO processed over 40,000 document requests and established a West Coast field office at Los Angeles, which later became the first DDC field office.

1.1.4 Armed Services Technical Information Agency

The Armed Services Technical Information Agency (ASTIA) was the immediate predecessor of DDC. ASTIA was created in 1951 by order of the Secretary of Defense. It took over the functions and most of the personnel from its predecessor, CADO, and continued in operation at the same location in Dayton, Ohio. The Secretary of the Air Force was given managerial control over ASTIA, but policy direction was dictated by the Department of Defense Research and Development Board. An ASTIA advisory council was appointed to assist the director in the operation of the Agency. The Secretary of the Air Force placed ASTIA under the direct control of the Air Research and Development Command.

Towards the end of 1952, ASTIA established an East Coast regional office at New York City. It continued to operate the regional office previously established by CADO at Los Angeles.

1.1.5 Navy contributions to the DDC collection

In 1941 the U. S. Government established the Office of Scientific Research and Development (OSRD) to act as a coordinator of the defense R&D effort. The 33,000 or more documents created by this office were later absorbed by the Office of Naval Research in 1946.

A major portion of these OSRD reports were indexed and cataloged by the Library of Congress under a contract to the Office of Naval Research. This effort, known as the Science and Technology Project, was terminated in 1949, and the documents became a nucleus for the Navy Research Section of the Science Division of the Library of Congress Reference Department.

1.1.6 Expansion of ASTIA

In May of 1953 ASTIA absorbed the Navy Research Section of the Library of Congress and thus acquired 150,000 documents. In the same year requests for documents exceeded the 100,000 mark. Services were expanded in 1957 by the addition of a field office at San Francisco.

In 1958 ASTIA outgrew its quarters at Wright Field, Dayton, Ohio, and moved to Arlington Hall Station in Arlington, Virginia. A field office was maintained at Dayton to service the growing aeronautical operations division at Huntsville, Alabama, in close proximity to Army's Redstone Arsenal.

1.1.7 Defense Documentation Center (DDC)

The most significant reorganization came about early in 1963 when the DOD issued an instruction naming ASTIA as the DOD Documentation Center for Scientific and Technical Information. This was followed by a subsequent instruction which expanded the ASTIA mission and actually reconstructed ASTIA as a new agency - the Defense Documentation Center for Scientific and Technical Information (DDC). In July DDC moved to more spacious accommodations at Cameron Station, Alexandria, Virginia. In September DDC established a technical operations division at L. G. Hanscom Field, Bedford, Massachusetts. The sequence of changes and expansions in missions, staff, and accommodations culminated in the incorporation of the new DDC as a field activity of the Defense Supply Agency on November 1, 1963. At this point, DDC had a collection of over 700,000 documents, and requests had exceeded the million mark.

1.2 Increasing Assignments of Responsibilities

1.2.1 Joint Air Force/Navy operation of CADO

With each change in the organizational structure of DDC, additional responsibilities were assigned. The Engineering News Service was originally authorized to serve only the U. S. Army Air Corps. When Colonel Albert A. Arnhym became chief of ADD in December of 1945, control of the organization still resided with the U. S. Army Air Corps. ADD began to serve a wider clientele when it contracted with the Institute of Aeronautical Sciences to establish a Standard Aeronautical Index System (SAIS). After ADD had completed the cataloging of 56,000

German documents and 3,000 Japanese documents in 1948, it was reorganized as CADO by the Air Force and Navy. Colonel Arnhym continued on as director on the new organization which was formally instituted by an operational order dated August 18, 1949.

1.2.2 Policy Direction of ASTIA by DOD R&D Board

A new tri-service agreement between Army, Navy and Air Force was issued in 1950 in which an Army officer was officially assigned as assistant director. CADO was converted by order of the Secretary of Defense into ASTIA in 1951 and was placed under the policy direction of the DOD Research and Development Board. Management control was retained by the Secretary of the Air Force.

1.2.3 ASTIA managed by ARDC

The Secretary of the Air Force delegated detailed management responsibility to the Air Research and Development Command, which appointed Mr. Leslie E. Neville as the first official director of ASTIA in October of 1951. ASTIA services were expanded considerably when the DOD Research and Development Board endorsed a policy that ASTIA provide services to other Governmental agencies related to DOD efforts. Up to this time, ASTIA services had been limited to DOD agencies and contractors.

1.2.4 Tri-Service Funding of ASTIA

In 1953, the Assistant Secretary of Defense (Comptroller) directed the Departments of the Army, Navy and Air Force to participate equally in the financing of ASTIA, and in February a tri-service regulation for operation was promulgated in Air Force Regulation 205-43, Army Regulation 380-60 and OPNAV Instruction 5510.17. The degree of reliance placed on the new ASTIA is evidenced by the transfer of over 50,000 documents from the Navy Research Section from the Library of Congress in May of 1953.

In 1954, funding for ASTIA reverted to the Air Research and Development Command and the Tri-Service ASTIA Advisory Council was replaced by the Assistant Secretary of Defense, ASTIA Policy Council. A 1956 amendment to the Tri-Service Directorate authorized ASTIA to provide unclassified documents to NATO nations.

1.2.5 Policy guidance by ASTIA Operational Liaison Committee

Colonel Woodrow W. Dunlop, appointed Commander of ASTIA in August of 1957, supervised the moving of the agency from its limited quarters at Dayton, Ohio, to larger quarters in Arlington Hall Station, Arlington, Virginia in February of 1958. A tri-service organization called the ASTIA Operational Liaison Committee was established in the same year to facilitate document acquisition and to foster greater utilization of ASTIA services to the Army, Navy and Air Force. Also in the same year, SEATO nations were added to ASTIA's authorized foreign release service. The ASTIA Policy Council was then abolished and new policy direction came from DOD from an office which later became the Office of the Director of Defense Research and Engineering.

ASTIA services were again expanded in 1960 when DOD authorized ASTIA to provide service to grantees and potential contractors of the military departments. Responsibility was increased when ASTIA was assigned to incorporate the current ARDC technical efforts (CATE) program into its recently established Research, Development, Test and Evaluation Management Data Project.

Operations were again expanded in July of 1961 under Colonel James O. Vann when ASTIA was authorized to supply the Department of Commerce with microfilm for sale to the general public of all the DOD unclassified, unlimited reports. In the next year responsibility was increased to encompass processing of Interdepartmental Data Exchange Program (IDEP) reports.

1.2.6 Tri-Service Staff Representatives

The Crawford Report on "Scientific and Technological Communication in the Government", presented by the Task Force to the President's Special Assistant for Science and Technology, had a very positive effect in increasing the centralization of DOD research and development reporting. The presentation of the report in April of 1962 was followed in May by the replacement of the ASTIA operational liaison committee with tri-service staff representatives. In the same month Dr. Charles L. Brenier became director.

The microfilm distribution program was expanded to include twelve National Science Foundation-Office of Technical Services Regional Technical Report Centers in Colorado, District of Columbia,

Georgia, Illinois, Massachusetts, Missouri, New York, Pennsylvania, Texas, Washington and California. A new ASTIA Huntsville Technical Operations Division was opened at the Army's Redstone Arsenal. In December of 1962, the DOD Technical Information Program was crystallized in DOD Directive 5100.36. This directive reaffirmed the central role of ASTIA as a major component of the information program and a central depository for all DOD research, development, test and evaluation documentation.

1.2.7 DDC Liaison Representatives

The Crawford Report in 1962 was followed by the Weinberg Report on "Science, Government and Information" published by the President's Science Advisory Committee in 1963. The publication was followed twelve days later by DOD Instruction 5129.43 which established ASTIA as the DOD Documentation Center for Scientific and Technical Information. DOD Instruction 5100.38 subsequently expanded the ASTIA mission and reconstructed ASTIA as the Defense Documentation Center for Scientific and Technical Information (DDC). With this instruction, the ASTIA tri-service staff became the DDC Liaison Representatives.

In July of 1963, DDC moved to new quarters at Cameron Station, Alexandria, Virginia, and in November DDC became a field activity of the Defense Supply Agency with a new director, Dr. Robert B. Stegmaier, Jr.

Throughout its long career, DDC has tended to grow in both size and stature as a major support effort to DOD research and development programs. DOD directives and instructions have increased this centralized role as a primary collector and disseminator of RDT&E information. With its subsumption under the Defense Supply Agency, DDC became an officially recognized tool of the entire DOD. This move, more than any other, symbolized the central policy control exerted by the Office of the Director of Defense Research and Engineering.

1.3 Analysis of Pertinent DOD Directives and Instructions

1.3.1 DOD Directive 5100.36

DOD Directive 5100.36 establishes a clear dichotomy between logistics information and technical information by providing for separate management of the DOD Scientific and Technical Information Program and the DOD Production Engineering and Logistics Information Program. It directs the military departments to establish a coordinated structure of generally decentralized information activities, and to designate representatives from these activities to provide single points of contact through which the Director of Defense Research Engineering can exert centralized policy control.

The directive instructs the Director of Defense Research and Engineering to establish a Director of Technical Information to supervise, coordinate, and review the DOD Scientific and Technical Information Program. It instructs the Assistant Secretary of Defense for Installations and Logistics to designate a representative to supervise, coordinate, and review the DOD Production Engineering and Logistics Information Program.

Information activities programmed and budgeted by components of the military departments are to provide information services within their assigned missions on a DOD-wide basis and are to coordinate their efforts to fulfill the requirements of all users. The Assistant Secretary of Defense for Public Affairs must approve all policies and procedures governing the dissemination of information to the public.

1.3.2 DOD Instruction 5129.43

DOD Instruction 5129.43, dated January 22, 1963, assigns specific functions for the Defense Scientific, and Technical Information Program. Military departments and other DOD components are given the responsibility for primary production and distribution, establishment and maintenance of local technical libraries, publication of technical journals, and the organization of symposia and technical meetings. Many specialized information analysis centers administered by DOD components, designated by the Director of Defense Research and Engineering, will provide DOD-wide services within their assigned missions. All DOD components are instructed to provide DDC and the specialized information analysis centers with all pertinent documentation resulting from DOD RDT&E.

The most detailed instructions pertain to the functions delegated to the Director of Defense Research and Engineering. Fifteen separate instructions provide for (1) overall supervision, coordination and review of the DOD Scientific and Technical Information Program; (2) review of meetings, primary production and distribution of technical reports, local libraries operations and journals established or supported by the military departments; (3) review and coordination of specialized information analysis centers with power to establish, consolidate, or cancel centers as necessary; (4) policy direction over DDC; (5) communication of RDT&E information into the Production Engineering and Logistics Information Program; (6) transfer of foreign technical intelligence and technical report translations to DDC and specialized information analysis centers; (7) coordination of public release procedures with the Assistant Secretary of Defense for Public Affairs; (8) delegation of responsibility for providing a central directory of DOD information activities; (9) maintenance of liaison with other Government and non-Government agencies actively engaged in improving information exchange; (10) delegation of responsibility for operating a clearinghouse of information on current DOD RDT&E programs; (11) establishment of DOD policies and standards for technical reports; (12) assurance of continuing program analysis of the DOD information program and provision of supporting information to the Five-Year Force Structure and Financial Program; (13) provision for the survey of problems and needs of users and establishment of standards of performance and measures of effectiveness of the DOD information program; (14) review and coordination of research and development programs pertaining to the improvement of the DOD information program; and (15) publication of a periodic directory of symposia and technical meetings.

The Director of Defense Research and Engineering is again instructed to appoint a Director of Technical Information who maintains continuous contact with responsible individuals designated by DOD components involved in RDT&E. This instruction is very clear in establishing the Office of the Director of Defense Research and Engineering as the official policymaker in matters pertaining to the transfer of technical information via technical reports, symposia, meetings and journals.

1.3.3 DOD Instruction 5100.38

A second DOD implementing instruction, 5100.38, dated March 29, 1965, further details the provisions of the above-mentioned Directive 5100.36 and Instruction 5129.43. This instruction em-

powers DDC to acquire all recorded information, regardless of its physical form or characteristics, from all sources, inside or outside of DOD, domestic or foreign, whenever this information is considered pertinent to RDT&E efforts and whenever this information is not made readily available to these efforts through other sources. It instructs DDC to announce technical reports, to provide documentation services on demand, to notify information analysis centers of technical report availability, and to cooperate with other agencies in developing standards for report dissemination, processing, distribution, advanced techniques, and equipment.

The instruction places DDC under the operational direction of the Director of Defense Supply Agency and under the policy direction of the Director of Defense Research and Engineering, with the Director of Technical Information as the focal point for policy implementation. Specifically, DDC is instructed to acquire, store, announce, retrieve, and provide secondary distribution of documents. The instruction is very specific with regard to the division of functions between DDC and DOD components. Detailed instructions to DDC include No. 4 "Maintain and improve a working vocabulary of terms and work toward vocabulary compatibility with other like activities for use in the processing of technical reports throughout the DOD/RDT&E effort."

DOD components are instructed to "establish and enforce contractual procedures which require that a minimum of 20 legible copies of each technical report, at least one of which is sufficiently good graphic quality as to permit reproduction of legible copies on a mass production basis, be transmitted direct to DDC no later than on the instance of primary distribution."

The four other instructions to DDC and six other instructions to DOD components are equally as detailed. For the first time DDC is instructed to provide complete unclassified services to all U. S. Government agencies, their contractors and grantees, including DOD potential contractors. Similar classified services are to be provided to all departments and agencies of the Executive Branch of the U. S. Government, including contractors, potential contractors, and grantees. Classified services to U. S. Government agencies, other than the Executive Branch, are to be controlled by the Director of Technical Information DOD R&E.

1.4 DDC's Role in the DOD RDT&E Community

1.4.1 Information analysis centers

DDC maintains a central registry of all agencies, contractors, and potential contractors who have need of documentation services from DOD-supported information analysis centers. DDC also supplies a major portion of document copies to the centers and compiles specialized bibliographies to the centers and their clients.

1.4.2 STINFO officers

Section 5 of DOD Instruction 5129.43 requires that the Director of Defense Research and Engineering shall maintain on his staff a Director of Technical Information who will act as a focal point for a network of scientific and technical information liaison (STINFO) officers, designated by other DOD components involved in RDT&E activities. One of the functions of the STINFO officers is to coordinate the interchange of information between DDC and the information generating or processing activity to which the office is attached. The STINFO officer is the contact point for obtaining an indication of the effectiveness of DDC services to DOD RDT&E programs and for ensuring that DDC is supplied with all RDT&E documentation.

1.4.3 Services to DOD RDT&E programs

DDC services are based on two basic information sources--technical documents and research resumes (DOD Form 1498).

Newly acquired technical reports are descriptively cataloged, subject indexed, abstracted, and announced in a bi-weekly Technical Abstract Bulletin (TAB). Indexes to these bulletins provide access by subject, corporate source, personal author, contract number, and report number. These indexes are cumulated quarterly and annually. The same access can be gained to full bibliographic data by performing a mechanized search through the automatic data processing records created by DDC in the course of publishing TAB. Special requests are referred to the specialized information analysis centers established throughout the DOD. Any document accessioned by DDC is made available on microfilm, microfiche, or full-size copy on demand.

In addition to technical document services, DDC maintains the Work Unit Data Bank which is an ADP record of information collected on DOD Form 1498 which describes both technical and managerial aspects of DOD RDT&E programs. This information is made available to authorized DOD requesters. The information is supplied in either a standard format or in a format and content dictated by the requester. DDC also maintains a central registry of all DOD information users and certified authorizations for need-to-know and facility clearance.

1.4.4 Services to DOD contractors

The same services are offered to DOD contractors, subcontractors, and potential contractors, except that information from the Work Unit Data Bank is not available to these civilian agencies.

1.4.5 Liaison with other Government agencies

DDC is instructed to maintain continuous liaison with all other Government information activities to ensure the fullest utilization of these resources for defense purposes and to observe and acquire new techniques in information processing.

Recently DDC has become a central focal point for an activity whose purpose is to develop a comprehensive technical vocabulary for indexing technical reports and for providing a dictionary for technical editing. The conduct and organization of this project parallel somewhat the earlier vocabulary-building activities of DDC in the various micro-thesaurus projects for specialized areas of research.

DDC also acts to provide other government agencies with advanced techniques in the application of EDP and image reduction equipment. DDC was a pioneer in the use of microfilm for storing and reproducing large numbers of documents. The first electrostatic reproduction units for enlargement copying of microfilm was placed in operation at DDC in June of 1956. DDC also established leadership in the use of electronic data processing equipment for providing and controlling documentation services. EDP equipment was installed as early as 1960. The original system was augmented again in 1962 and the entire ADP system was replaced by a larger computer in December of 1963.

2. PRESENT DDC MISSION ELEMENTS (JULY 1, 1966)

The following description of DDC Mission Elements has been developed through discussions with DDC management and after study of the basic DOD Instruction 5100.38 and other DDC documents. The Mission Statement below is considered current; however, no attempt is made at this point to forecast additions or modifications to the DDC mission.

2.1 Management Information Services

2.1.1 Work unit information system

A data bank containing RDT&E work unit data is to be maintained for the DOD Research and Engineering by DDC in accordance with DOD Instruction 7720.13. The system (data bank) will provide all echelons of the DOD with (1) ready access to basic technical management data on DOD research and exploratory development work currently in progress, (2) a common base for coordination and correlation, and (3) convenient and accurate summaries of statistics on a DOD-wide basis.

2.1.2 Contractor performance data system

2.1.2.1 Evaluation report service

Performance evaluation information (as used by DOD source selection boards and contracting officers to review contractors' past performance) are to be maintained by DDC as data banks operated manually for OASD, I&L. This information is used now when procurements are in excess of $2 million, but dollar level will be reduced. Scope is expected to broaden to cover contractors other than those in RDT&E.

2.1.2.2 Cost reduction report service

Identical with 2.1.2.1.

2.2 Technical Information Services

2.2.1 Secondary distribution

This category includes distribution or disclosure of technical reports subsequent to primary distribution of documents to

an initial list of recipients. Secondary distribution usually occurs as the result of a request.

2.2.1.1 Accessions

Accession, selection, review, cataloging, and technical analysis of documents related to RDT&E and sources of RDT&E information are the operations to be performed. The responsibility for providing DDC with technical reports for secondary distribution rests with the originating DOD (sponsoring) organization. Acquisition functions include obtaining documents originating within DOD sponsoring organizations and from outside the DOD community, domestic or foreign, when they are considered pertinent to DOD RDT&E efforts and if not readily available through other sources.

2.2.1.2 Announcement

Prompt and well-indexed announcements of newly acquired technical reports are to be provided through an abstract-index journal and other media to announce the existence and availability of documents.

2.2.1.3 Selective dissemination of microfiche

As a means of improving secondary distribution services, technical libraries and large DOD contractors are to be furnished with selected but nearly complete (e.g., limitation 5) sets of DDC-held documents in microform. Other DOD contractors, with interest limited to specialized subject areas, will receive microfiche sets by subject class.

2.2.1.4 Document copy on demand

Timely response is to be provided to authorized requests for copies of technical reports and other documentation services, observing and handling document distribution in accordance with DOD information control policies, standards, criteria, and procedures.

2.2.1.5 Bibliography request processing

Reference services are to be provided on either a demand or anticipatory basis, including documents, reference

to documents, referral to other document sources, and related services in response to authorized requests.

2.2.1.6 Microfiche copy for bid packages

DDC plans to supply procurement officers with a sufficient number of copies of selected technical reports in microform to provide all prospective contractors on proposed procurement of research and development efforts with a bid package complete with related subject area technical reports. (This program has not been activated throughout DOD as yet, but is being taken into account in current DDC microfiche production plans.)

2.2.2 Central registry for users of DOD scientific and technical information

A central registration point is to be operated for users of DOD Scientific & Technical Information. Approved registrants are permitted access to the collections of DDC and DOD Information Analysis Centers.

2.2.3 Primary distribution of technical reports from United Kingdom, Canada, and Australia

Primary distribution is to be made to recipients in the U. S. of technical reports selected by originating agency or requested by U. S. recipient.

2.2.4 Referral on significant DOD information resources

DOD resources in science and technology are to be identified, and descriptions on these resources cataloged and correlated. Advice and guidance about these resources are to be provided to authorized organizations and individuals requiring access to them by responding to requests for documents, information, and/or referral assistance.

2.2.5 STINFO handbook maintenance

This mission (now inactive) includes the acquisition, compilation, and publication of resource directory information, as well as procedures and policies for government agencies and contractors concerned with use of DOD Scientific and Technical Information programs and activities.

2.2.6 Maintenance of working vocabulary

Although presently curtailed while awaiting the results of the DOD-wide vocabulary development effort under Project LEX, this mission is expected to be reactivated under suitable guidelines to assure continued internal maintenance and improvement of working vocabularies needed to carry out internal DDC production activities and provision of service to users.

2.3 Development Plans and Programs

2.3.1 Test, evaluate, and apply developed techniques and equipment

Techniques and equipment directly applicable to advancing DDC's capability to provide documentation services are to be tested and evaluated. Where new techniques and equipment are needed, other organizations, including suppliers, are encouraged to expend resources to carry out new developments.

2.3.2 Systems planning

Development of improved and new product services and techniques, as well as increased operational effectiveness and efficiency through greater systems integration, is a continuing DDC responsibility.

2.4 Mission Interpretation and Planning

Broadly interpreted, DDC's mission is to provide scientific and technical information services within its assigned scope of responsibilities to strengthen the capabilities of the DOD and the armed forces. It is assumed that DDC responsibilities include the continuing evaluation of the effectiveness of its activities and the frequent reappraisal of alternative operating concepts that hold potential for improved service to meet DOD/RDT&E user needs.

Proceeding on this assumption, IDC has included in this study a preliminary consideration of several alternative STINFO communication systems and service concepts to hypothesize future requirements for DDC capabilities. However, over-all DOD/RDT&E STINFO communication system plans must be authoritatively developed before

long range (5 year) plans for DDC development actions can be considered completely responsive to projected DOD/RDT&E STINFO communication system requirements.

3. OBJECTIVES AND REQUIREMENTS IN STINFO COMMUNICATION

3.1 Introduction

The DOD possesses vast resources of scientific and technical information. These are such that probably not even an accurate accounting exists for all of these resources, although the recent studies in the EDIS program have gone far in identifying libraries and other repositories of scientific and technical information within the Army. In carrying out its mission, the DOD faces demanding obligations for the effective exploitation of these information resources. Furthermore, although there is no formal national information system within which the DOD exists as a component, there are a host of dependencies on the external world for sources of scientific and technical information. Furthermore, the DOD plays certain roles in furnishing information generated within the Department to users outside the DOD community.

In this section we are concerned with examining the nature of the requirements which rest upon and within the DOD for the effective conduct of their internal missions, insofar as these depend on scientific and technical information. We shall not consider the external system beyond the point of making certain assumptions which assist in thinking about the nature of the dependencies which the DOD has on the outside technical community, but which cannot be in any sense considered a mission for the DOD. It is DOD's own internal requirements which will be stressed here, for it is our purpose to discover what roles the DDC may logically assume in order to effect the requirements of the DOD.

In developing requirements at the DOD level, which eventually are translated into specific roles for any particular component, it is necessary to look at DOD as a mission-oriented task group. Its mission as such says nothing about information or information services. However, the tasks to be accomplished by the operational components certainly depend on the availability of information of a wide variety of types, and it is thus immediately deduced that a provision must be made for information service support. It is from this overall requirement, then, that the specifics of DOD information requirements must stem.

It is not necessary to deal with DOD operational missions in great detail, except to realize that DOD exists as an implement of na-

tional policy; that this may occasion the application of military force, applied either defensively or offensively; and that to do this effectively, those forces must be as well organized and equipped with modern machinery for warfare as is possible. The unique nature of this machinery means that research, development, engineering, production, and procurement resources of vast magnitudes must exist to bring the physical hardware into being. If support of the national policy is the basic reason for the existence of the military establishment, a long sequence of successively deducible requirements emerge, all of which must be met in order to achieve the overall objective.

Accordingly, this section will provide a very brief review of the background of the STINFO Program of DOD (Section 3.2), and develop DOD STINFO requirements based on the program objectives (Section 3.3). To place these activities in the DOD operational mission context, an outline of the overall Research and Development and Procurement Cycle of DOD is developed in Section 3.4. Finally, with this context in hand, attention is turned (in Section 3.5) to the deductions of logical and feasible roles which are being played or might be played by DDC in the STINFO communication system.

3.2 DOD STINFO Program

The concept underlying the entire DOD Scientific and Technical Information program is stated in DOD Instruction 5129.43 of January 22, 1963. This concept envisaged a program consisting of a decentralized but coordinated structure of information activities operating within and administered by the military departments and other DOD components. The overall management responsibility for the Program was assigned to the Director of Defense Research and Engineering, who was to maintain on his staff a Director of Technical Information for administration of the Program.

The concept further called for the retention and maximum use of existing information activities engaged in the handling and dissemination of scientific and technical information, and for these to serve as a base upon which to develop a DOD-wide coordinated system of documentation centers, information centers, and libraries for providing necessary information and information services to all DOD component organizations.

In addition, DDR&E was instructed to arrange for the continued coordination with other elements of the Federal Government and the public scientific and technical community.

The heads of all DOD components involved in RDT&E activities were instructed to: (1) maintain a continuous review of their STINFO needs and propose such new programs and activities as might be required; (2) maintain an inventory of STINFO activities under their administrative control; (3) assure that information generated within their activities be provided promptly to appropriate centers and libraries; and (4) encourage the interchange of scientific and technical information among technical people both within the DOD community and without, via symposia, technical society meetings, and open publication.

3.3 Development of Requirements

The major objective of a DOD STINFO program is to support both effective management and effective conduct of research, development, procurement and production programs. The following requirements fall naturally into three groups: those related to management, those related to conduct, and those related to "system."

3.3.1 Requirements related to management of RDT&E

3.3.1.1 To achieve the maximum possible reduction in average time consumed in both the R&D and I&L phases of the total time cycle between recognition of a military capability requirement and the satisfaction of that requirement.

The consumption of a total of 5 to 10 years for a major procurement is not uncommon, although there have been remarkable exceptions, achieved through careful management or crash programs. The introduction of new tactical or strategic concepts often leads to new equipment requirements, such as for a new family of weapons. It is quite possible that military requirements may have changed drastically by the time the procurement is completed.

3.3.1.2 Provide for the overall management control of RDT&E programs throughout the DOD.

Effective management of R&D is mandatory at DOD level in order to:

(a) Effectively program for the expenditure of time, money, and manpower resources.

(b) Accomplish the coordination and phasing of large and complex development and procurement programs.

(c) Avoid unprofitable overlap and redundancy in research and developmental efforts in process in widely separated parts of DOD.

All these subsidiary requirements depend on the availability of special types of information dealing with program and project status, estimates of completion dates, specially identified problem areas, and overall awareness of the nature of related programs.

3.3.1.3 To improve the cost/effectiveness in performance of R&D and procurement and production programs.

Several factors relate to cost/effectiveness in R&D and procurement activities, among which are:

(a) Control and reduction of costs for contract support.

(b) Contractor performance.

(c) Establishment of realistic production and R&D milestone objectives.

(d) High quality specification data for design and procurement and production activities.

(e) Effective technical liaison between contractor and procurement agencies.

Special requirements here imply highly responsive information systems which not only can furnish timely information but can also respond to query. Programs presently underway deal with many aspects of cost and effectiveness requirements.

3.3.2 Requirements related to the conduct of RDT&E

3.3.2.1 To generally improve the quality of research, engineering, and procured material and services.

This requirement relates to the quality of end product, which is obviously dependent on the complete awareness of all aspects of technology involved. It has implications with respect to the aggregate currency of state-of-the-art knowledge, and to the intrinsic scientific and technical capabilities of both DOD and contract personnel.

3.3.2.2 To provide for the rapid entrance of internally generated information into the DOD STINFO "system."

Certain subsidiary requirements are related to the general requirement of encouraging the rapid entrance of internally generated information into the DOD STINFO system:

(a) Even tentative, partial, incomplete, or negative information on the results of R&D efforts can be of importance to those about to undertake similar studies. Publication of interim results or the channeling of these into the DOD STINFO system can aid others in choosing fruitful lines of approach with consequent reduction of unrewarding efforts.

(b) Timely entrance of tentative results can serve to muster further technical know-how to the solution of the problems. The ability to query the information system for sources of possible consultative aid should be a worthwhile capability.

(c) The processes of critique of final reports, preparation of position papers, and final approval for release, can

substantially delay the availability of currently useful results. The reduction of unwarranted delays for such reasons should be encouraged.

3.3.2.3 To reduce, to the greatest extent possible, impediments to the free flow of information among and within the component organizations of the DOD.

Due to the complexity of inter-organizational interfaces, or of inter-functional relationships, it is possible that much information flows through the system either very slowly or not at all. There are several possible causes for this, and these - or others - should be sought out and eliminated:

(a) Misapplication of security or need-to-know policies.

(b) Over-zealous proprietary concern, even to the point of thwarting the free-flow of unclassified information to the detriment of related research.

(c) Clumsy or protracted procedures for release of reports or data.

3.3.2.4 To promote the active cross-fertilization of RDT&E functions and I&L functions.

The flow of information across the functional interfaces between RDT&E and I&L should be encouraged. A uni-directional flow from a user requirement stage to research; through development, test, evaluation; to procurement, production and, finally, field evaluation; is a slow process involving years. The possibility that requirements may have changed, or that the real-world environment has changed by the time the cycle has been completed, is large. Continual back-reference to earlier functional steps in the process, or continual overwatching of the entire process can help reduce expenditure of resources or preclude the development of capabilities which are no longer pertinent.

3.3.2.5 To utilize effectively new scientific developments and technological advances made outside DOD.

DOD has every reason to exploit the resources of the external scientific and technical community with respect to new discoveries or technological advances. Any STINFO system should surely provide for methods of maintaining awareness of all such activities with a view to exploring them for possible application to DOD problems. A knowledgeable and systematic overwatch should be maintained on the open literature for this reason.

3.3.2.6 To provide for the continuing training of DOD scientific and technical personnel both in disciplinary areas and in DOD applications areas.

Education and training are only general aspects of communication of information. It is important that training, even of highly qualified DOD scientific and technical personnel, be fostered. It is easy for any person exclusively engaged in some narrow (albeit very important) task to lose his contact with allied disciplines or even with his own. Continuing programs of training and briefings on recent developments in disciplinary or application areas can help obviate the tendency toward overspecialization and professional sterility.

3.3.2.7 To provide for the direct interchange, at unclassified levels, of scientific and technical information between DOD personnel and the external R&D community.

The direct interchange of scientific and technical information between DOD personnel and the rest of the technical community is worthy of continuing emphasis. Within reasonable limits due to security and proprietary considerations, such exchange should be fostered. Although this is in fact a part of present concepts, it should receive even more positive emphasis.

3.3.3 Requirements related to a DOD STINFO "system"

3.3.3.1 To support the development of true "information systems" in the armed services and other DOD components which may eventually be integrated into a DOD-wide system.

DOD should recognize the need for eventual systematization of its information resources. To this end, such system development inside component organizations should be supported and coordinated so that such systems (subsystems) will be able to interface effectively with others.

3.3.3.2 To provide the system structure within DOD that supports and controls the component subsystems as they emerge.

During the period of evolution toward a DOD system (rather than a program), attention should be devoted to design of the network within which the component subsystems will lie. This means that interface requirements will have to be carefully defined. Such a net will have to be designed so as to support the components in the accomplishment of their missions, as well as to exercise control over them.

3.3.3.3 To assure that the evolution of a DOD STINFO system take cognizance of trends toward Federal and other large-scale information systems with which a DOD system may be required to interface.

There are strong and unrelenting forces at work today, tending toward very large national information systems, especially in technological areas. Eventually such systems will come into being and any DOD system must be able to interface effectively with them, in order to enjoy the resources which they may offer.

3.3.3.4 To provide for continued research, development, and training in the fields of information utilization, and information management.

The ideas of large-scale information systems and the possible advantages that they may offer are relatively new. While these may not come into being full-blown, much has to be learned in order that the evolution toward that objective be orderly. Thus DOD, and indeed its component organizations, should undertake continuing research into information technology, the management of information resources, and the utilization of information.

3.3.3.5 To provide, in the DOD system, for the capability to produce products and services that are not within the purview of any one component subsystem, but that are of general utility to the scientific and technical community.

A major reason for the existence of a DOD-wide "system" lies in deriving capabilities beyond those of any one component. For example, a total system would have the potential of providing:

(a) Manifold increases in accessibility to scientific and technical information.

(b) Surveys and state-of-the-art reviews on a current basis.

(c) Identification of technical areas in which little is being done, with the purpose of assessing the value of initiating research in such areas.

(d) Inter-disciplinary and inter-functional bibliographic and abstract or extract services.

3.4 The Research and Development and Procurement Cycle

3.4.1 The progression of steps

The maintenance of modern, well-organized, and well-equipped forces for the execution of DOD operational missions depends on an extremely large and complex system for research and development in organizations and tactics, in weapons and equipment, and for effecting procurement and production of weapons and equipment. These three major activities are in progress at all times, and there is an intricate relationship among them.

The diagram of Figure B-1 shows in a highly simplified way the relationships among the several functions involved. The test and evaluation functions are shown separately from the research and development functions, for some of the feedback loops depend on their separation. Procurement and production functions are shown together, even though it is recognized that both may proceed in phases, having interconnections with other functions occurring between phases.

3.4.1.1 Organizational and tactical RDT&E

Although normally one thinks of the "R&D Cycle" as referring to ultimate procurement of equipment, it is worthwhile to recognize that the fundamental requirements that lead to all these activities are those expressing necessary and desirable combat capabilities. The eventual requirements for hardware ensue from organizational and tactical conceptual studies that are in progress at all times. During actual field combat operations, of course, direct requirements appear either for new equipment or modifications of old equipment to meet new tactical problems. In addition to studies of organization and doctrine, there are also often protracted periods of test and evaluation relating thereto. Although the focus of this study is on RDT&E of the more common sort, the tactics and organization areas are included for completeness.

3.4.1.2 Equipment RDT&E; procurement and production

The diagram of Figure B-2 shows in some detail the RDT&E and I&L (procurement and production) activities in an equipment area. It is noted that there are many successive steps that may be involved from the initiation of a requirement to its ultimate

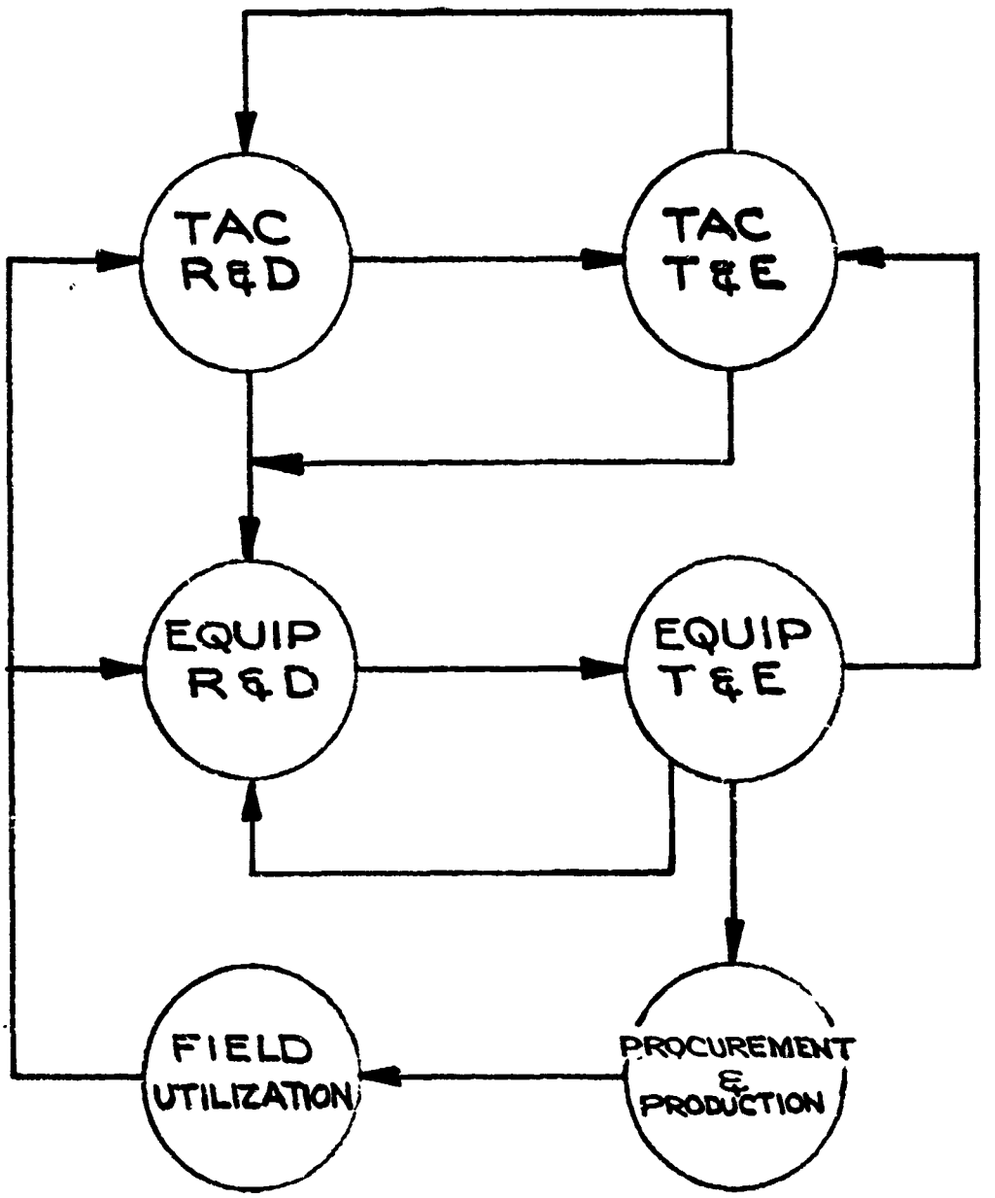


Figure B-1 Functional Relations in the RDT&E and Procurement Cycle

achievement. In some cases some steps may be by-passed or compressed in time, but the normal progression is as shown.

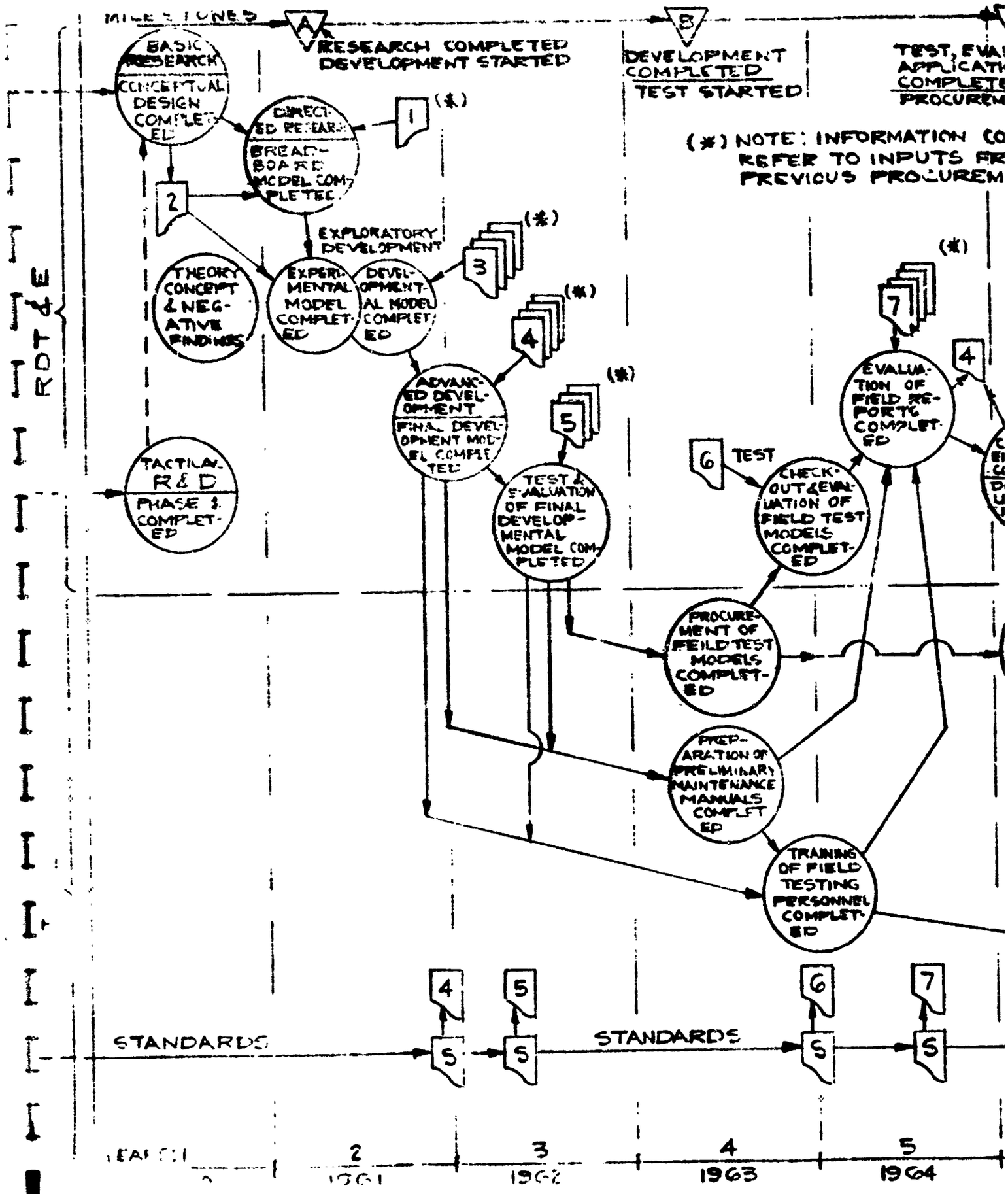
Information is generated at each activity step and flows forward in the progression. However, there is much feedback as far as functions are concerned, so that the cycle can be viewed as truly an iterative one. It is not difficult to see that the whole process may be very much protracted, and that requirements exist to be able, through improved information flow and management control, to reduce the time consumption. It is clear that if the cycle is too extended the military requirements responsible for the initiation of the development and procurement sequence may have changed before the material becomes available.

It may be remarked parenthetically, however, that too rapid a cycle would not be an unmixed blessing. Since the least certain part of the planning and implementation progression to meet combat requirements is anticipating the nature of military obligations of the future, too responsive a system could lead to expensive and wasteful procurement. The fear that such might ever be the case, however, is probably groundless.

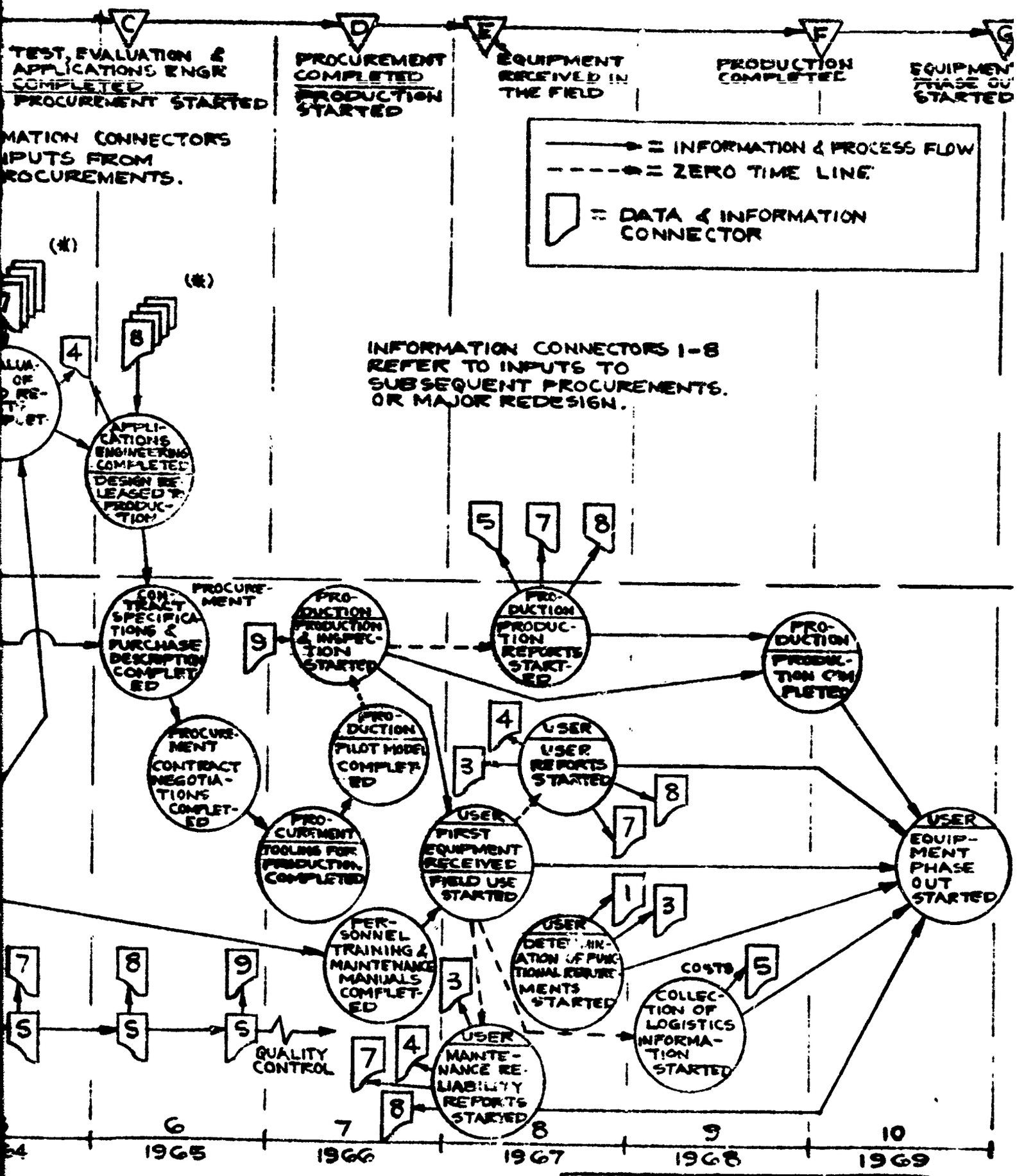
3.4.2 Information flow between the RDT&E and I&L functions

A close examination of Figure B-2 will show that, in addition to the long sequence of tasks connected by forward flow of information, there is strong functional feedback, much of which stems from user reports and production reports, but some of which arises early in the cycle at the output of field test and evaluation. The former tend to affect subsequent procurements, but the latter may call for major redesign or rework program.

Of special interest in this diagram is the cross-relationship of RDT&E functions and those functions nominally in the I&L area. The tendency to divide the information problem into two parts, one relating to RDT&E and the other to I&L, seems to be the consequence of an organizational accident. From an overall DOD mission requirement approach there seems to be no justification for such compartmentalization, for, as can be seen, there is much interdependency. In fact, if the DOD STINFO program requirements as developed in Section 3.3 above are accepted - especially those related to R&D


MILESTONES
A
RESEARCH COMPLETED
DEVELOPMENT STARTED
B
DEVELOPMENT COMPLETED
TEST STARTED
TEST, EVA
APPLICATI
COMPLETE
PROCUREM
(*) NOTE: INFORMATION CO
REFER TO INPUTS FR
PREVIOUS PROCUREM
RDT&E
BASIC RESEARCH
CONCEPTUAL DESIGN COMPLETED
DIRECTED RESEARCH
BREAD-BOARD MODEL COMPLETED
EXPLORATORY DEVELOPMENT
THEORY CONCEPT & NEGATIVE FINDINGS
EXPERIMENTAL MODEL COMPLETED
DEVELOPMENTAL MODEL COMPLETED
ADVANCED DEVELOPMENT
FINAL DEVELOPMENT MODEL COMPLETED
TEST & EVALUATION OF FINAL DEVELOPMENTAL MODEL COMPLETED
TACTICAL R&D
PHASE 3 COMPLETED
TEST
CHECK-OUT & EVALUATION OF FIELD TEST MODELS COMPLETED
EVALUATION OF FIELD REPORTS COMPLETED
PROCUREMENT OF FEILD TEST MODELS COMPLETED
PREPARATION OF PRELIMINARY MAINTENANCE MANUALS COMPLETED
TRAINING OF FIELD TESTING PERSONNEL COMPLETED
STANDARDS
STANDARDS
YEARS
2
1961
3
1962
4
1963
5
1964

A



TYPICAL PROCUREMENT CYCLE & TECHNICAL INFORMATION FLOW

FIG. B-2

Program Management - then such segregation can have deleterious effects.

While it is true that there are many distinctions in the specific characteristics of information flowing in the I&L area and that in the RDT&E area, they are basically of a pedantic nature. While it may be desirable that principal attention be on RDT&E technical reports, it is certain that I&L material is of equivalent importance to the overall R&D and procurement cycle and that impedance to its flow and utilization is just as serious a problem. Even though responsibility for the DOD STINFO program lies inside DODR&E, it may be worthwhile considering feasible roles that DDC or a similar agency might play in an overall DOD information system.

It is not the purpose of this study to explore in detail the problems related to I&L information and its utilization. However, the study scope does include considerations regarding DOD-wide scientific and technical information systems, and these must eventually either comprehend, or at least interface with, all major bodies of working information.

3.5 Logical Roles and Mission Requirements for DDC in the Communication of Scientific and Technical Information

3.5.1 Overall DDC missions

DDC, as a major element in the DOD STINFO activity, already has numerous mission assignments which have been discussed in Section 2. In the past, the depository and secondary distribution functions for scientific and technical information have been the principal requirement. Recently, however, information processing activities in support of management information services have been emphasized, and now this mission takes precedence over all others. From the point of view of production activities, the various services of the secondary distribution function consume the major portion of DDC resources. In addition to these two areas, DDC has a continuing responsibility to study the applications of new techniques and equipment, and conduct systems planning for the entire operation.

3.5.2 Functional DDC requirements

In the development of the requirements statements to follow, it is assumed that, for the period of this projection (1967 - 1971):

(a) The broad areas of mission responsibilities for DDC will not change. That is, the three major areas of concern throughout the period will be: Management Information Support; Technical Information Services; and Applications Development and Test and Evaluation in pursuit of the two operational mission areas.

(b) The relative emphasis now existing on the operational missions is unlikely to change, although specific elements within these areas will.

(c) Extension and expansion in kind and quality of services relating to both mission areas will occur as applications development studies reveal more effective methods of providing such services, as better tools become available through technological advances, and as more ways are devised to exploit the information resources of DDC in support of DOD operational missions.

(d) The STINFO flow interfaces between DOD and the non-DOD community of the Federal Government will become more active, stronger, and more purposeful, although the existence of any operational "Federal Information System" is doubtful by the end of the period.

(e) The possibility of the existence of a DOD-wide "STINFO System" by the end of the period is sufficiently real that DDC is obliged to consider its roles within such a system, and maintain constant awareness of the trends in this direction.

In connection with services in support of R&D management in DOD, that mission area which now enjoys number one priority, DDC should:

(a) Carefully evaluate the project and program management information requirements associated with both RDT&E and procurement and production, to identify where DDC's information resources may be applied.

(b) Through studies of these requirements and resources, devise extended service concepts that can be offered to DOD.

(c) Evaluate the problems of acquisition of raw management information from R&D activities inside DOD, and from contractors, in order that more complete and timely management information services may be offered.

In connection with Technical Information Services, presently the second priority mission area, DDC should:

(a) Examine carefully the information flow patterns that exist within the entire R&D and procurement cycle, to identify areas in which DDC's present resources may be brought to bear to facilitate the processes and lead to generally higher quality or more effective performance of development functions.

(b) Promote, to the greatest possible extent, real progress toward information services that respond to specific information requirements both rapidly and accurately.

(c) Develop the capability to provide information services of an analytical sort, such that state-of-the-art learning curves are steepened.

(d) Consider methods of bringing both the source community (mainly originators of DOD technical writings) and the user community to the point of real awareness that they are active parts of the STINFO system; this toward the objective of eventually developing (1) acceptable and uniform input procedures and formats, and (2) output subsystems geared to user requirements and limitations.

C. SUMMARY OF DDC'S PRESENT PRODUCTION CAPABILITIES FOR HANDLING MICROGRAPHICS

1. PRESENT SERVICE FUNCTIONS USING MICROGRAPHIC MEDIA

DDC provides two kinds of services which depend upon the use of micrographic media. Such media are used predominantly for producing document copies in either micrographic form or hard-copy form. The use of micrographic media for enlargement viewing at the six DDC field services is less noteworthy in terms of volume, but nonetheless important in terms of the value of the service provided. These uses of micrographic media are discussed below.

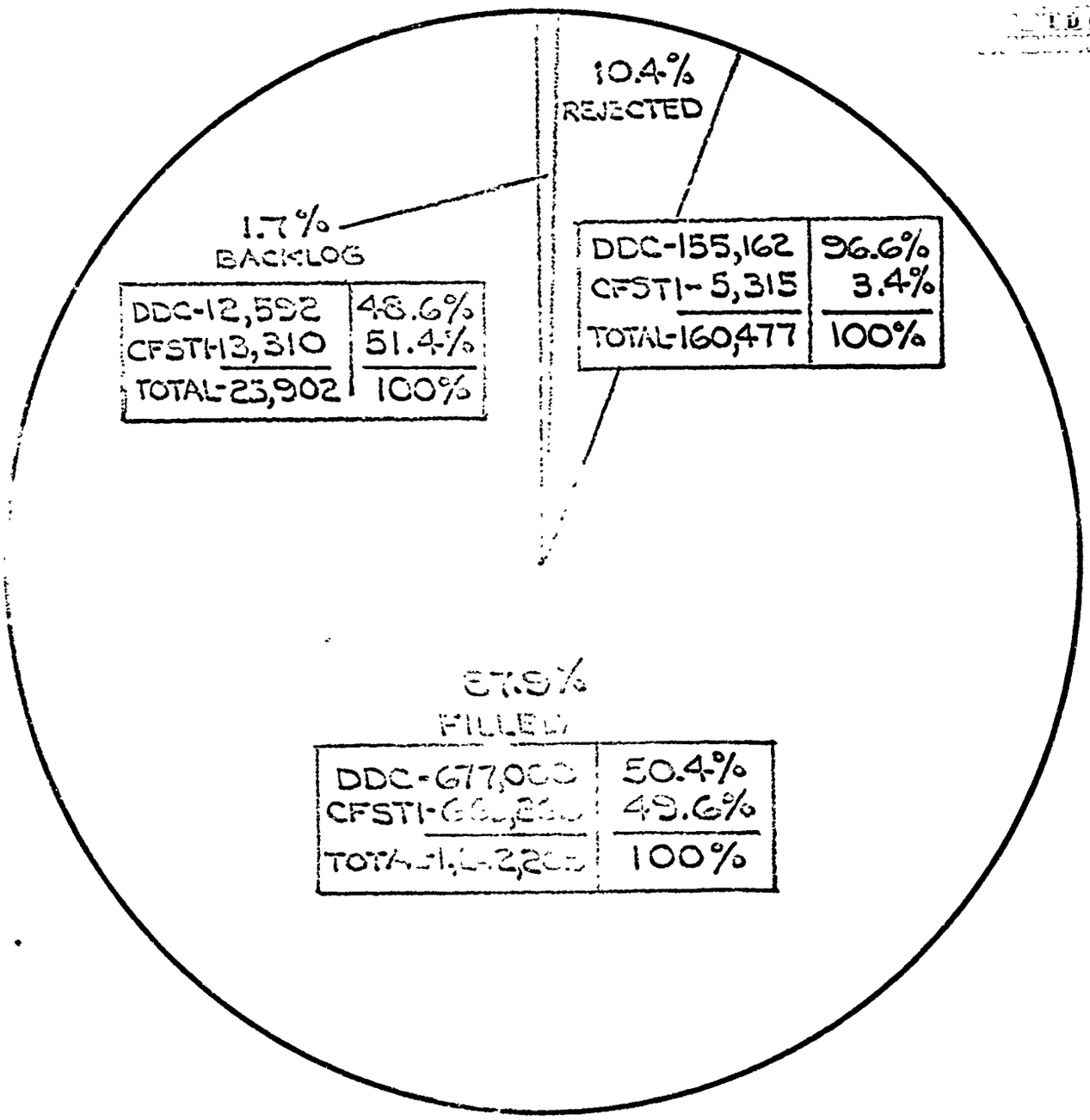
1.1 Request Processing

One of the primary functions of DDC is to provide secondary distribution of documents which are important to the support of DOD research and development efforts. Document supply constitutes a major portion of the total DDC workload and consumes a major part of the DDC budget.

In FY 1966, DDC had on hand or had received 1,528,647 requests for documents (see Figure C-1). All but 25,902 (1.7 percent) were processed during the year. Approximately 10 percent of the requests processed were rejected either because the requester was not certified to obtain DDC services or because DDC or CFSTI did not have the document. Of the requests filled, DDC supplied 50.4 percent of the requested copies and CFSTI supplied 49.6 percent. During FY 1966, DDC shipped 677,000 document copies either in full size or micrographic form. CFSTI shipped 665,268 documents. Figure C-2 shows the proportions of these documents which were classified, unclassified/limited and unclassified/unlimited.

Sometimes a qualified requester submits a request for a document which is not in the DDC collection. If the document should have been included in the collection, steps are taken to acquire it; 35 percent of all document acquisition actions are generated by requests for documents (see Figure C-3). If the document is acquired, it is processed as a normal acquisition but may not be announced in TAB.

Figures C-4 and C-5 show the percentages of copy requests filled by DDC and CFSTI which involve the use of micrographic media. Roll microfilm and microfiche are used to produce copies of roll microfilm or microfiche or to produce full-size copies by enlargement printing.

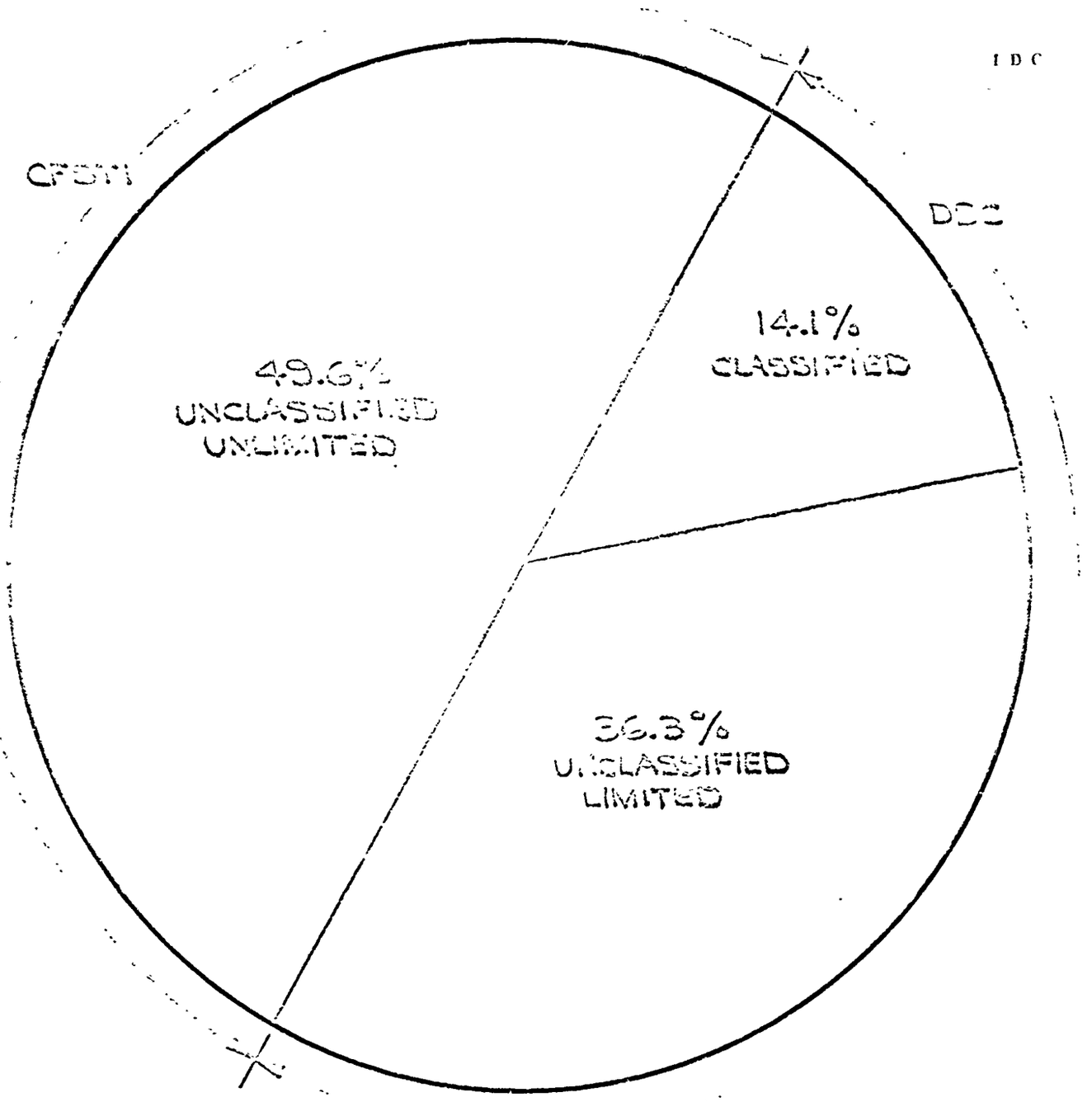


TOTAL REQUESTS AVAILABLE FOR PROCESSING

DDC-[illegible],754	55.3%
CFSTI-[illegible]	44.7%
TOTAL-1,528,647	100%

DISPOSITION OF DOCUMENT REQUESTS
FY 1966 DDC/CFSTI

Figure C-1

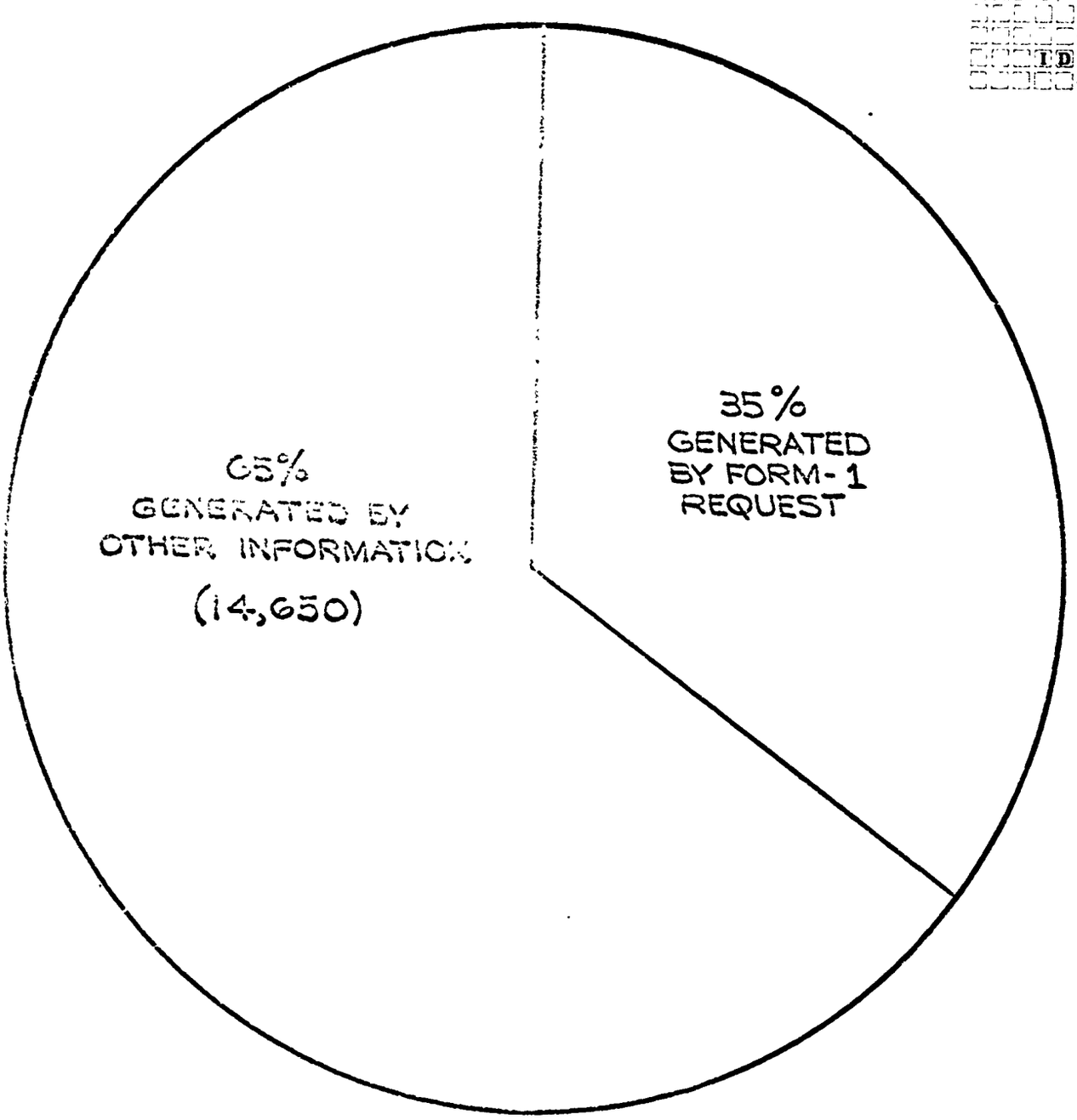


TOTAL REQUESTS FILLED

[illegible]	[illegible]%
[illegible]	[illegible]%
[illegible]	100%

[illegible]

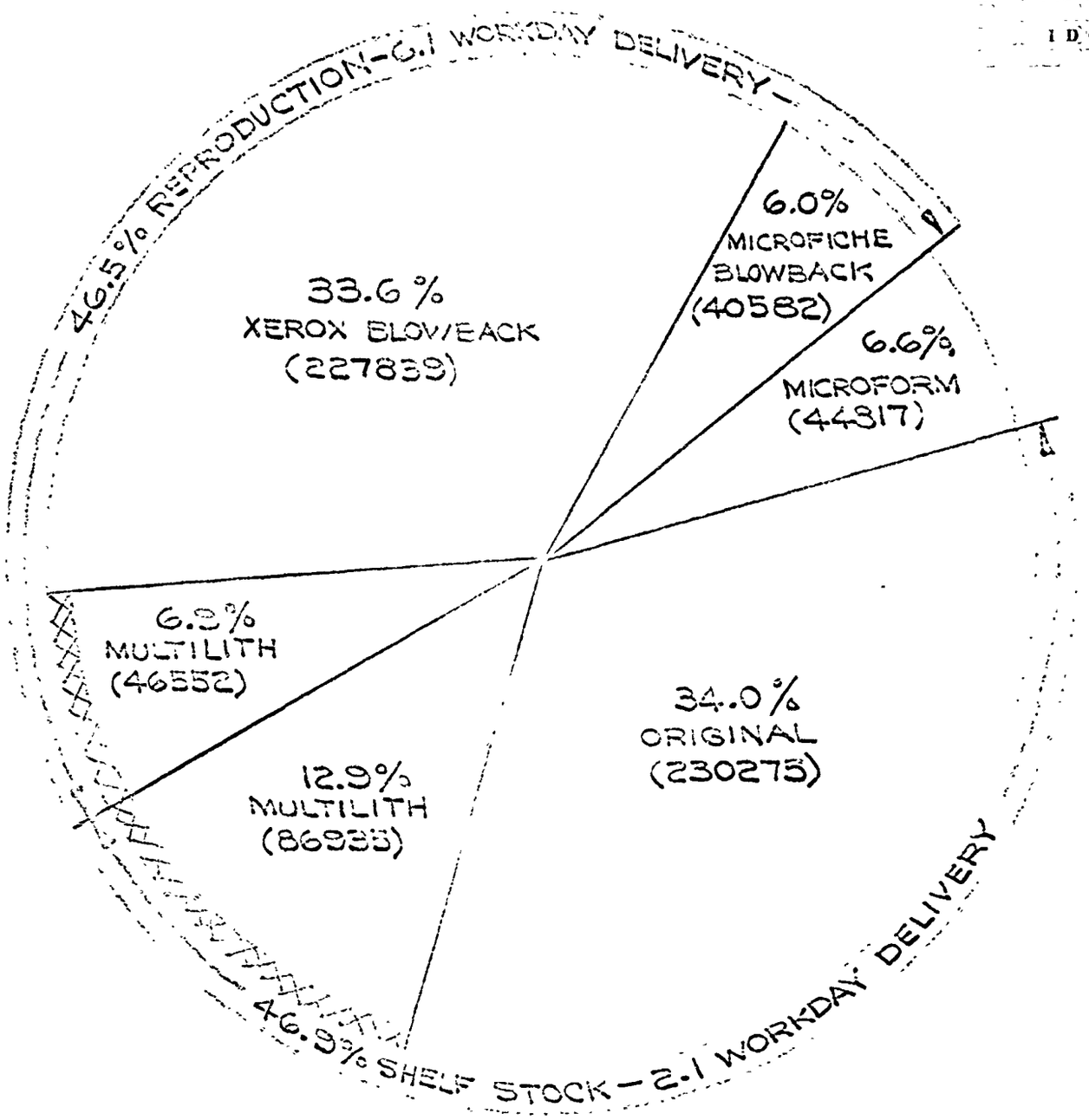
Figure C-2



TOTAL ACQUISITION ACTIONS AVAILABLE
FOR PROCESSING
22,527

DOCUMENT ACQUISITION ACTIONS
- METHOD OF GENERATION -
FY 1966 DDC

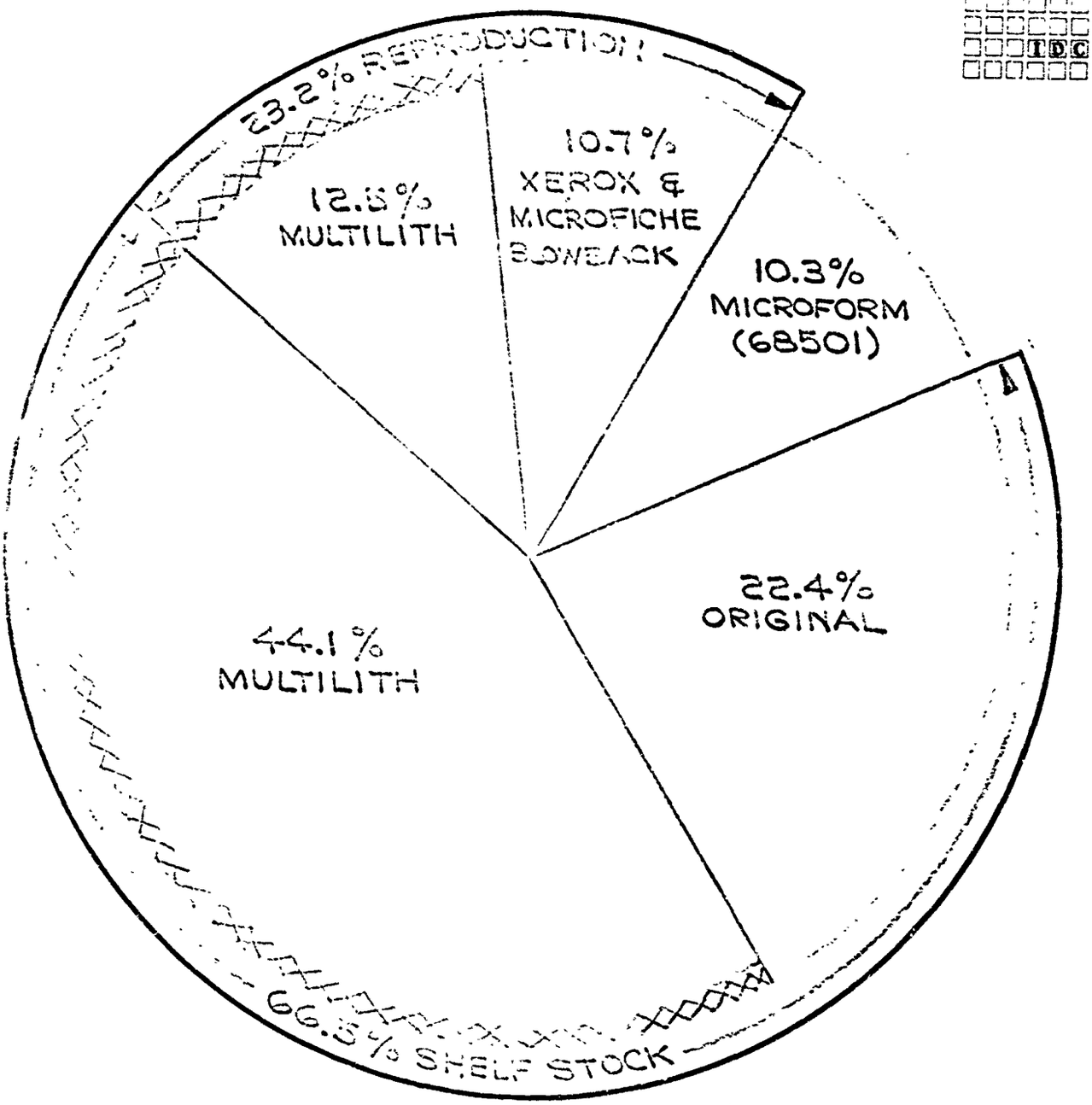
Figure C-3



TOTAL REQUESTS FILLED
677,000

METHOD
COPY REQUEST FULLFILLMENT
FY 1966-DDC

Figure C-4



TOTAL REQUESTS FILLED
665,268

Figure C-5

METHOD OF
COPY REQUEST FULFILLMENT
FY 1966 - CFSTI

1.1.1 Microform-to-hard-copy reproduction

Figure C-4 shows that DDC satisfies 34 percent of document requests with original copies from shelf stock. CFSTI supplies 22.4 percent from original shelf stock (see Figure C-5). These are the copies originally supplied by DOD agencies and contractors per DOD instruction. When original shelf stock is used up, DDC and CFSTI must utilize blow-back from microform either to obtain a multilith mat for reproduction of full-size copies or to obtain single full-size copies by direct blow-back onto paper.

Of the copies supplied by DDC, 19.8 percent are obtained from multilith mats created on a Xerox Copyflo machine from roll film. CFSTI relies on this method to supply 56.5 percent of the copies. Of DDC's copies 12.9 percent come directly from multilithed shelf stock as the result of a pre-stock action previously taken. Of CFSTI documents 44.1 percent come from multilithed shelf stock. Some multilith copies, however, are printed as a result of current document requests pending fulfillment. More copies are printed than are immediately needed so that some copies can be put on the shelf for future use. This accounts for 6.9 percent of DDC copies supplied and 12.5 percent of CFSTI copies supplied.

Over one-third of DDC-supplied copies are obtained by full size blow-back onto ordinary paper from roll film or microfiche. CFSTI utilizes this method for only 10.7 percent of document copies. At the present time, only 6 percent of the total number of document copies supplied are derived from microfiche at DDC; 33.6 percent of the copies are obtained by xerographic blow-back from roll film. As the microfiche collection grows at both DDC and CFSTI, the ratio of xerographic blow-back from roll film to hard-copy blow-back from microfiche will decrease because the demand for older documents on roll film will eventually diminish to a negligible fraction of the total copy demand.

The present relationship between blow-back from microfiche and from roll film is very much influenced by DDC's current practice of dual microfilming of documents. If less than three original copies are obtained by DDC on primary distribution, the document is microfilmed on both microfiche and roll film. The roll film is used to generate a Xerox multilith mat for printing a stockpile of 25 or more copies. Also, when an original stock of 20 copies has been used up, a shelf copy is retained for microfilming on roll film so that multilith mats

can be obtained. Hard-copy blow-back from microfiche is used only when demand for a particular document is very low. Thus, copy production is purposely more heavily weighted towards blow-back from roll film onto paper or multilith masters. This policy is followed because of the unavailability of multilith masters suitable for use in the present microfiche blow-back equipment.

1.1.2 Microform-to-microform reproduction

Microfiche or roll film is sent to the requester only if the original order so specifies. Of copies by DDC, 6.6 percent are copies supplied on either roll film or microfiche, whereas 10.3 percent of CFSTI's copies are supplied on microform. Only a very small demand is made for roll film; most microform copies are supplied on microfiche. Requests for microfiche from DDC fluctuate widely from month to month. Demand in April was double the figure for March and dropped back to the previous level in May. These fluctuations reflect very closely the promotional activities of DDC and other agencies to increase the use of microfiche in Government agencies and industrial organizations.

The total use of microfiche for filling copy demands by microfiche-to-microfiche duplication or full-size blow-back accounts for only 12.6 percent of DDC production, even though the major portion of document requests are for documents which have been recorded on microfiche.

1.2 Automatic Distribution of Microfiche

Recently, DDC investigated the feasibility of automatic distribution of microfiche to DOD agencies and contractors. Several companies and agencies were approached to submit information requirement profiles specified in terms of DDC descriptors. These descriptors were then used by DDC subject specialists to create Boolean expressions for searching through current selections of DDC document input. Microfiche were assembled on the basis of the search outcome and sent to the respective companies and agencies. The packages of microfiche were inspected by the recipients to determine the percentage of relevant documents retrieved. Results of this pilot study are still being analysed to determine the feasibility of selecting current documents on the basis of either descriptors or COSATI categories.

Microfiche copies of all documents announced in TAB are automatically distributed to six DDC Field Services, an Extension Service at Huntsville, Alabama, and to the NASA and AEC Headquarters.

1.3 Document Viewing

In terms of numbers, the proportion of documents viewed on microfiche or roll film is small compared to the number of full-size copies reproduced from microfiche or roll film. But the importance of the viewing activity may be equal to the importance of supplying full-size copy.

The major portion of viewing activity is devoted to a document screening process. The intent of the person viewing the microfiche or roll film is to select from a large number of documents those which he wishes to obtain in full-size copy. A relatively small portion of the viewing activity is concerned with visual extraction of information from the page image.

The reliance on viewing of microform for document selection is primarily due to the present DDC Field Service operating code and equipment configuration. The user tends to optimize the time he must spend at the DDC Field Service by scanning the largest number of documents that might satisfy his information requirements. The user is encouraged to copy only those pages which he needs for immediate use. A sampling of the use of microfiche and roll film at the Field Services indicates that a very high percentage of documents scanned are eliminated from further consideration. The scanning process drastically reduces the number of full-size copies that the user will order at a later date. Some users have found that as little as 5 percent of the documents scanned will be needed in full size.

1.4 Microform Document Request Patterns

Over 90 percent of the documents ordered in microform are ordered by company and Government agency librarians who have either scanned the current TAB or who have placed dual document orders for both microform and full-size copies of the same document. At the present time, the microform copies are being stockpiled by librarians in anticipation of future demands. A very small portion of microform copies go directly to the person who will ultimately use the information contained in the documents. This state of affairs is created because most microform readers and reader-printers are located in the library, rather than at the user's desk.

2. DESCRIPTION OF PRESENT DDC MICROGRAPHIC ACTIVITIES AND FACILITIES

2.1 Organization

Micrographic activities are concentrated under the Directorate of User Services (DDC-O), Publication Division (DDC-OP) (see Organization Chart in Figure C-6.) The Publication Division is responsible for all publishing activities including the preparation of forms and internal DDC publications, full-size document copies, and document copies on roll microfilm and microfiche.

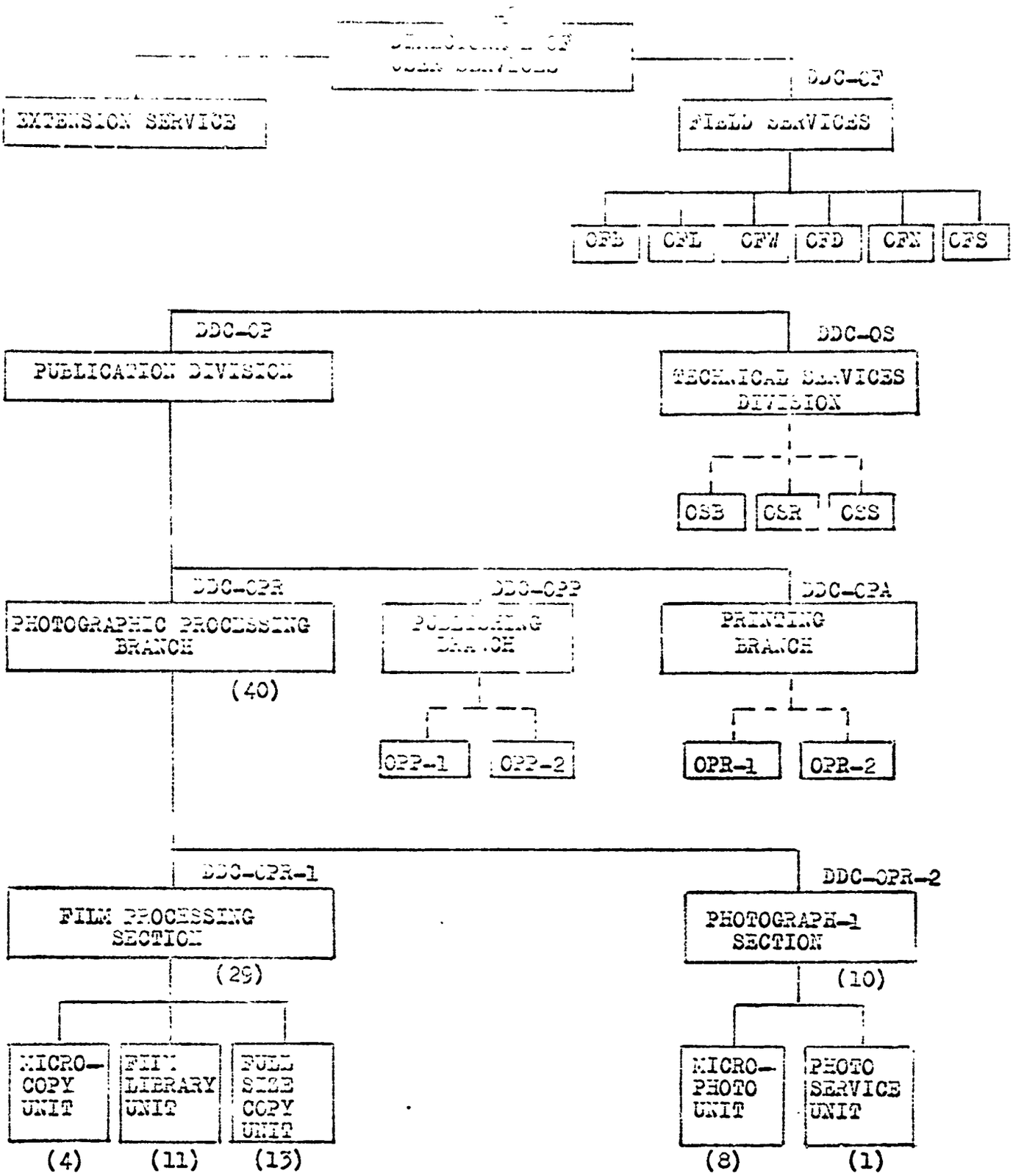
The Publication Division is divided into three branches as shown in Figure 6. Handling of microfilm and microfiche is concentrated in the Photographic Processing Branch, which is sub-divided into the Film Processing Section and the Photography Section. The Photography Section microfilms documents and develops and edits the resulting microfilm. The Film Processing Section stores the microfilm and uses it to produce duplicate microfiche and roll film, full-size copies from microfiche and roll film, and offset masters from roll film.

The Photographic Processing Branch is staffed by 40 people, 29 of whom are in the Film Processing Section and 10 in the Photography Section. In the Film Processing Section there are 4 people in the Microcopy Unit (film-to-film duplication), 11 people in the Film Library Unit, and 13 people in the Full-Size Copy Unit. The Photography Section has 8 people in the Microphoto Unit and one person in the Photo Services Unit. Each section has a section supervisor who reports to the branch chief.

2.2 Functional Responsibilities

2.2.1 Photography section

The Photography Section produces all original microfilm used and distributed by DDC. Almost all microfilm is prepared in conjunction with services provided to DDC users. A negligible amount of microfilming is performed on internal records. Primarily, documents are microfilmed on 105mm roll film for production of microfiche. However, some microfilming is performed on 35mm film for splicing into previously produced roll film or for production of paper offset plates on the Xerox Copyflo machine. The microfilming operations are performed by the Microphoto Unit.



ORGANIZATION

Figure C-6

The Photo Services Unit develops, inspects and edits the roll film coming from the Microphoto Unit and also edits previously produced roll film and microfiche which have been stored in the film library.

2.2.2 Film processing section

The Microcopy Unit is responsible for roll-to-roll and microfiche-to-microfiche duplication, both for automatic distribution to field services and for filling microcopy requests. The Full-Size Copy Unit operates the Xerox Copyflo machines for producing full-size copy from roll film and the Microcard microfiche printers for printing full-size sheets from microfiche. The Film Library Unit is the depository for all microfilm except that which is stored in the Washington Field Service. The film library should contain a complete collection of all DDC microfilm, both past and present production, and the film for producing documents in the Air Technical Intelligence (ATI) series and Technical Information Pilot (TIP) series. The Film Library Unit also supplies original film to the Photography Section for editing.

2.3 Process Activities

2.3.1 Photography Section

The processes performed by the Photography Section are described in sequential order in Table C-1. Figure C-7 is a summary of the processes and items processed, while Figure C-8 defines the processes. Areas of interest are discussed in detail in the following paragraphs.

2.3.1.1 Document preparation for microfilming

The microfilm camera operators in the Microphoto Unit perform several time-consuming operations in preparing documents for microfilming, since no special personnel are assigned to sort, screen, unbind and rebind documents.

Documents are received from Technical Service Division already separated into AD numerical order and into two major categories: classified and unclassified. The camera operators then separate the classified documents into the following sub-groups: NATO confidential, NATO secret, U.S. confidential, U.S. secret. The

TABLE C-1

SEQUENTIAL PROCESSING STEPS FOR PHOTOGRAPHY SECTION

Step	Process	Item Processed	Explanation
1	Transport in	Documents	Receive documents from Technical Service Division
2	Store	Documents	Store documents on work table for operator pickup
3	Copy	Log Sheet	Copy AD number and date received on to log sheet
4	Copy	Log Sheet	Copy limitation code from change list to log sheet
5	Transport in	Change List	Receive computer listing of changes daily
6	Transport in	Title Strips	Recieve title strips from Lithography Section bi-weekly in AD number order
7	Store	Title Strips	Hold title strips until needed
8	Match/Merge	Title Strips & Documents	Match title strips to documents
9	Transport internal	Documents & Title Strips	Carry documents and title strips to camera
10	Unpack	Documents	Remove document binding
11	Copy	Documents	Mark over illegible AD numbers and copy numbers on document covers
12	Compare	Documents & Title Strips	Compare for agreement of AD number and title
13	Microfilm	Documents & Title Strips	Microfilm documents
14	Copy	Form 0-8	Fill out microfilm reel sheet

TABLE C-1 (CONT'D.)

Step	Process	Item Processed	Explanation
15	Sort	Documents	Sort out documents received in only one or two copies
16	Store	Documents	Store unbound documents until film inspection completed
17	Store	Documents	Store all documents received in only one or two copies in a separate group
18	Store	Microfilm	Store microfilm for latent image fade
19	Copy	AFSC Form 185	Fill out reel log
20	Store	Title Strips	Store title strips in a box
21	Transport internal	Microfilm	Carry microfilm to film lab
22	Copy	Form 17	Fill out time card
23	Copy	Log Sheet	Complete log sheet
24	Copy	Daily report	Prepare daily report
25	Copy	Retake Sheet	Copy reel to retake sheets
26	File	Form 0-8	File reel sheets
27	Retrieve	Documents	Retrieve unbound documents for retake action
28	Pack	Documents	Rebind documents on accepted film
29	Transport out	Documents	Take over-size documents to bindery. Take bound documents to Technical Services Division
30	Transport in	Microfilm	Receive exposed film from Microphoto Unit
31	Process	Microfilm	Develop microfilm

TABLE C-1 (CONT'D.)

Step	Process	Item Processed	Explanation
32	Store	Microfilm	Store microfilm for proofreading
33	Inspect	Microfilm	Inspect film for background density, resolution, fogging, operator errors and camera malfunction errors
34	Edit	Microfilm	Mark defective frames with pen
35	Pack	Microfilm	Place roll film in containers
36	Copy	Retake form	Copy AD numbers onto retake form
37	Transport out	Microfilm	Send acceptance microfilm to Microcopy Unit
38	Transport out	Retake lists	Send retake lists to Microphoto Unit

PROCESS ACTIVITIES	Documents & Errata	Film Roll	Film-Fiche	Daily Report Form	Re-Take Form	Log-Book Form	TAB ADP List	Change Notice List (Computer)	Daily Production & Time Card (17)	Camera Operator's Filming List (0-8)	Reel Log AFSC 185	Title Strip	DSA 11 Errata Form	DDC 0-13 Doc. Order to Storage	DSA Disposition Form (Reclass. Notice)			
FILE				X	X	X		X	X	X	X	X	X		X			
SORT	X																	
GROUP	X																	
COPY	X			X	X	X		X	X	X	X							
PACK	X	X				X				X	X	X						
UNPACK	X	X										X						
MICROFILM	X											X						
TRANS-IN	X	X	X				X	X				X		X	X			
TRANS-OUT	X	X	X	X			X							X				
TRANS	X	X				X						X						
COMPARE	X	X		X		X			X			X						
MATCH/MERGE	X											X						
MERGE	X																	
LOOK-UP	X	X		X	X	X	X	X	X	X	X	X						
RETRIEVE	X			X	X	X		X	X	X	X	X						
INSPECT	X	X		X	X	X			X	X	X	X						
EDIT		X	X															
PROCESS		X																
CUT		X																
SPLICE		X																
FORMAT	X																	
	X	X	X				X	X	X	X	X	X						
		X						X										

X FREQUENT X INFREQUENT

PHOTOGRAPHY SECTION MICROPHOTO UNIT
& PHOTOSERVICE UNIT
Figure C-7

PROCESS DEFINITIONS

STORE	Store temporarily on shelves or work tables. Retrieval is keyed to a process cycle. Storage time has upper limit, but lasts from several hours to several weeks.
FILE	Insert item in alphanumerically sequenced file. Unscheduled retrieval.
SORT	Put group of similar items in alphanumeric sequence.
GROUP	Separate group of items into sub-groups by some rule.
COPY	Transfer information from one item to another, or to a different place on the same item.
PACK	Bind, insert into canister, cassette, envelope, loose-leaf binder, etc.
UNPACK	Remove binding, remove from canister, cassette, envelope, etc.
MICROFILM	Set up, adjust, and operate microfilm camera.
TRANS-IN	Transport in by hand, truck, conveyer belt or other means.
TRANS-OUT	Transport out by hand, truck, conveyer belt or other means.
TRANS	Transport within the confines of the work area.
COMPARE	Compare like items in two different groups of items. Items retain their original grouping.
MATCH/MERGE	Compare like items in two different groups of items and form a third group consisting of matching items in the two other groups.
MERGE	Interfile two groups of items in alphanumeric sequence to form a single group.

FIGURE C-8

PROCESS DEFINITIONS

LOOK-UP	Locate and remove an item in a file or group.
RETRIEVE	Locate and remove an item in a file or group.
INSPECT	Check for acceptability according to specific criteria, either visually, mechanically, or otherwise.
EDIT	Make changes to information in an item or add information (not copy)
PROCESS	Process with chemicals, heat, etc; transform.
CUT	Cut a roll into standard-sized pieces or into units.
SPLICE	Connect together a group of individual pieces to form a roll.

FIGURE C-8 (Cont'd)

four classified sub-groups and the unclassified documents are further separated into those which will be announced in the current Technical Abstract Bulletin (TAB) and those which will not be announced. During grouping operations and subsequent handling and microfilming, AD numerical order must be maintained within all groups and security regulations must be observed for all classified material.

Unbinding and rebinding of documents constitutes a significant portion of the microphotography workload, although the rebinding operation is scheduled during periods of low microfilming activity. Unbinding operations are often difficult because of the variety and strength of the original bindings. Wire side-stitching must be removed with pliers and wirecutters; glued spine construction must be carefully handled because of the possibility of ripping pages when the binding is separated; and some bindings must be sent to the bindery to be cut off with a power knife. Equipment is on hand for rebinding documents up to a certain thickness with plastic combs or wire side-stitching; thicker documents must be sent to the bindery for heavier wire stitching.

Prior to microfilming the camera operator must also number parts of foldout pages and check classified documents to ensure that classification markings on individual pages are legible. For microfiche filming, the operator must compute the number of microfiche required for the entire document so that he will have the proper numbering, i.e., one of N, two of N, etc.

2.3.1.2 Microfilming

During microfiche filming the camera operator must set up various targets which will be readable without magnification after the film is developed. On the first microfiche, in the second row and second column, a target is microfilmed containing the sheet number, total number of sheets, AD number, and the NBS 1010 microcopy resolution chart. On classified and unclassified limited distribution documents, the next frame contains the following limitation statement: "The classified or limited status of this document applies to each page thereof unless otherwise marked. Separate page printouts must be marked accordingly." The last frame of the microfiche contains the word "END" and the date of filming. On trailer microfiche, the second frame in the first row contains the sheet number and total number of sheets; the next frame contains applicable distribution markings if the document is classified and limited. The AD number, sheet number and total number of sheets are set up with movable numbers by the camera

operator. The resolution chart and limitation statement are on preprinted targets which are placed on the camera bed. Any images remaining in the microfiche are exposed to a black page target.

2.3.1.3 Film processing

Since defective microfiche are not removed from the roll film, very little cutting and splicing are performed in the Photo Service Unit. Splicing of 105 mm film is accomplished with tape or staples.

2.3.1.4 Errata changes, retakes and refilming

When an errata film is received from the Microphoto Unit, the proofreader orders the original silver film masters from the film library and changes the frame containing the number of microfiche to reflect the addition of the errata microfiche to the set.

Errata to NATO documents, classified documents and unclassified documents are filmed on separate reels. Errata pages are accompanied by a DSA Form 11 from the Technical Services Division. On receipt of the errata pages, the supervisor looks up the film format of the original document so that the camera operator will know whether the errata sheet should be filmed on 35mm or 105mm film. If the errata is filmed on 105mm film, an entire microfiche is used even though only one errata page may be involved. AD number targets and errata sheets are filmed in a close-packed arrangement on 35mm film. Errata rolls are kept in one piece for roll-to-roll duplication for subsequent distribution to other holders of the DDC film collection, including the six field services and extension service.

For changes in classification, distribution limitations and availability, any document originally filmed on microfiche is ordered from the storage area, changed and refilmed. The new microfiche replaces the old. For documents on roll film, changes are filmed on 35mm film, duplicated, cut and spliced onto the appropriate film strips stored in the film library. Duplicate copies of the changes on roll film are distributed to all holders of the collection.

Documents corresponding to defective microfiche are refilmed. The camera operator retrieves the unbound reports from temporary storage shelves and refilms the documents on the end of the film roll currently in the camera. Documents which are

already in storage are ordered on a DDC Form 0-13. Retakes are ordered by the Photo Service Unit, the Film Library Unit or the Microcopy Unit, depending on which unit discovers a defective microfiche or film strip. Sometimes film is damaged through handling in the Microcopy of Full-Size Copy Units during film-to-film duplication or hard-copy enlargement.

2.3.2 Film procuring section

2.3.2.1 Storage and retrieval

The storage and retrieval processes performed by the Film Library Unit are described in sequential order in Table C-2. Figure C-9 is a summary in matrix form of the processes and items processed.

When validated requests for documents are received from the computer room on DDC Form 1 EAM cards, the cards have been sorted in AD number ascending order. The AD numbers are used for reference in the various separation steps (see Table C-2).

All Form-1's in the 400,000 AD number series are removed from the card deck for full-size copy orders and sent to document storage to check for availability of a shelf copy (steps 7 and 8, Table C-2). This procedure is necessary because a significant number of orders routed to the film library can be satisfied from hard-copy inventory, even though the computer indicates that all copies have been used.

If, when performing steps 11 through 13, a microfilm is found to be in the pre-stock cycle, a hand-written card bearing the AD number of the document and date of pre-stock initiation is filed in the current pre-stock file. This file is compared against current orders so that individual orders will not be filled by hard-copy blowback for documents which will shortly be available in multiple copies from multilithed pre-stock.

Both 35 and 16 mm roll film are sorted in cassettes in large map cabinet drawers. By referring to the AD number, the file clerk can determine if the document is on 16 mm film, 35 mm film or microfiche (105 mm). Cassettes of film strips are removed from the file cabinets in numerical order and stacked in trays. The

TABLE C-2

SEQUENTIAL PROCESSING STEPS FOR STORAGE AND RETRIEVAL OF ROLL FILM AND MICROFICHE FOR ORDER FULFILLMENT BY FILM LIBRARY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Form-1's	Receive Form-1 from computer room
2	Store	Form-1's	Store Form-1
3	Transport internal	Form-1's	Transport Form-1 to work station
4	Store	Form-1's	Store Form-1's at work station until needed
5	Group	Form-1's	Separate Form-1's into orders for microcopy and full size
6	Group	Form-1's	Separate microcopy orders into orders for roll film and microfiche
7	Group	Form-1's	Separate out Form-1's in the 400,000 series for hard copy orders
8	Transport out	Form-1's	Send 400,000 series hard-copy orders to document supply section for check on availability of full-size copies in stock
9	Transport in	Form-1's	Orders for 400,000 series documents returned from document supply section
10	Merge	Form-1's	Merge Form-1's left over from previous day with current Form-1 input including 400,000 series cards returned from document supply section
11	Compare	Form-1's and pre-stock list	Check Form-1's against pre-stock list to discover whether an ordered document is currently being pre-stocked

TABLE C-2 (CONT'D.)

Step	Process	Item Processed	Explanation
12	Group	Form-1's	Pull cards for items being pre-stocked
13	Transport out	Form-1's	Send Form-1's for items being pre-stocked to bindery
14	Group	Form-1's	Separate Form-1's for hard-copy orders into two groups requiring retrieval of microfiche or roll microfilm
15	Group	Form-1's	Separate hard-copy orders requiring roll microfilm originals into number sequences stored in different sets of cabinets
16	Retrieval	Roll microfilm	Retrieve cassettes containing microfilm from cabinet
17	Group	Roll microfilm	Separate roll film into groups requiring one, two, three or more than three copies
18	Unpack	Roll microfilm	Remove microfilm from cassettes
19	Splice	Roll microfilm	Splice together all roll microfilms requiring the same number of copies. For roll microfilm requiring more than three copies make up a roll for paper-plate generation.
20	Copy	Form 0-21	Fill out Form 0-21 for each reel of spliced microfilm
21	Match/Merge	Form-1's and Roll film	Match up Form-1's with each roll of microfilm spliced together
22	Pack	Roll film, Form-1's and Form 0-21	Put items into a pre-numbered envelope

TABLE C-2 (CONT'D.)

Step	Process	Item Processed	Explanation
23	Store	Form-1's, Form 0-21, empty cassettes and roll film	Store items for pickup by Full-Size Copy Unit
24	Transport out	Roll film, Form-1's, and Form 0-21	Transport items to Full-Size Copy Unit
25	Retrieve	Microfiche	Retrieve microfiche from cabinets
26	Copy	Form 0-21	Fill out Form 0-21
27	Pack	Form-1 and Form 0-21 and microfiche	Place items in pre-numbered envelope
28	Store	Form-1's, Form 0-21 and microfiche	Store items for pickup by Full-Size Copy Unit
29	Transport	Form-1's, Form 0-21 and microfiche	Transport items to Full-Size Copy Unit
30	Retrieve	Roll microfilm	Retrieve roll microfilm for requests for roll microfilm copy
31	Unpack	Roll microfilm	Remove roll microfilm from cassettes
32	Splice	Roll microfilm	Splice roll microfilm strips into larger rolls
33	Copy	Form 0-21	Fill out Form 0-21
34	Store	Roll microfilm	Store film for pickup by Microcopy Unit
35	Transport	Roll microfilm and Form 0-21 and Form-1's	Transport items to Microcopy Unit
36	Retrieve	Microfiche	Retrieve microfiche for orders for microfiche copies

TABLE C-2 (CONT'D.)

Step	Process	Item Processed	Explanation
37	Copy	Form 0-21	Fill out Form 0-21
38	Store	Microfiche, Form-1's and Form 0-21	Store items for pickup by Microcopy Unit
39	Transport out	Microfiche, Form-1's and Form 0-21	Transport items to Microcopy Unit
40	Transport in	Roll film, Form 0-21 and cassette	Receive items from Full-Size Copy Unit or Microcopy Unit
41	Store	Roll film, Form 0-21 and cassette	Store items
42	Cut	Roll film	Break down 100-foot rolls into document microfilm strips
43	Pack	Roll film	Insert filmstrips into cassettes
44	Compare	Form 0-21 and film	Compare items received against Form 0-21 to check for completeness
45	Sort	Roll film	Sort roll film into AD number order for re-filing
46	Destroy	Form 0-21	Destroy Form 0-21
47	File	Roll film	Refile roll film in cassettes
48	Transport in	Microfiche and Form 0-21	Receive microfiche from Full-Size Copy Unit or Microcopy Unit
49	Store	Microfiche	Store microfiche until ready to file
50	Compare	Form 0-21 and microfiche	Compare microfiche with Form 0-21 to assure complete return of film

TABLE C-2 (CONT'D.)

Step	Process	Item Processed	Explanation
51	Sort	Microfiche	Sort microfiche into AD number order
52	File	Microfiche	File microfiche

PROCESS ACTIVITIES	Form-1	Form 0-21	Roll Film (strips)	Microfiche
FILE			X	X
SORT			X	X
GROUP	X		X	X
COPY		X	X	X
PACK	X	X	X	X
UNPACK			X	X
MICROFILM				
TRANS-IN	X	X	X	X
TRANS-OUT	X	X	X	X
TRANS	X	X	X	X
COMPARE		X	X	X
MATCH/MERGE	X		X	X
MERGE			X	X
LOOK-UP				
RETRIEVE			X	X
INSPECT			X	X
EDIT		X		X
PROCESS				
CUT			X	
SPLICE			X	
FORMAT				
	X	X	X	X

X FREQUENT X INFREQUENT

FILM PROCESSING SECTION
FILM LIBRARY UNIT

Figure C-9

cassettes are sorted into four groups, depending on whether one, two, three or more than three copies are to be made. Any document in the last group which bears a number above AD 335,000 or 400,000 is removed for pre-stock action. Documents below these numbers are not pre-stocked, even though current demand exceeds three copies.

The roll films for full-size copy within each group are spliced together, end to end, to form 100-foot rolls (step 19). If microfilm in any group contains continuous tone-images, it is kept in a special reel. A similar grouping and splicing operation is performed on roll film which is to be duplicated to roll film (steps 30 through 35). In the case of microfiche, there is no necessity for grouping the orders according to the number of copies requested.

On return of the roll film from the Microcopy Unit or Full-Size Copy Unit, the tray containing the empty cassettes corresponding to each roll is located; the individual documents are cut from the roll and inserted into the cassetts; and the cassettes are returned to the storage cabinet. Returned microfiche are sorted into numerical order and returned to the microfiche storage cabinets.

The film library also accomplishes downgrading and upgrading of roll film and microfiche. Table C-3 is a sequential listing of the process steps involved. A computer printout is received from the computer operation to indicate the accession numbers whose classification has changed. Standard 35 mm targets, pre-filmed in the Photography Section, are used to replace the classification coding presently at the beginning and end of each roll film master. In the case of microfiche masters, the silver emulsion is scraped to remove the classification, and the new classification is written in with an acetograph pen. The cassetts and protective envelopes containing the effected film are also marked to indicate the classification change.

2.3.2.2 Duplication-microfiche-to-microfiche and roll film-to-roll film

Sequential processing steps are presented in Table C-4. Figure C-10 is a matrix summary of the processes and items processed.

TABLE C-3

PROCEDURES FOR UPGRADING AND DOWNGRADING MICROFICHE AND ROLL FILM BY THE FILM LIBRARY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Classification Change List	Receive notice of change in classification
2	Group	Classification changes	Divide changes into two groups: one for roll changes and one for microfiche changes
3	Retrieve	Microfiche or roll film	Retrieve microfiche or roll film
4	Unpack	Roll film	Remove film from cassettes
5	Cut	Roll film	Remove old classification target
6	Cut	Roll film	Cut off new target
7	Splice	Roll film	Splice in new target
8	Pack	Roll film	Put film into cassettes
9	File	Roll film	Refile roll film
10	Unpack	Microfiche	Remove microfiche masters from protective envelopes
11	Edit	Microfiche	Scrape off old classification and write in new classification
12	Pack	Microfiche	Replace microfiche in protective envelopes
13	File	Microfiche	Refile microfiche
14	Edit	Classification Change Lists	Record date of classification change on change list
15	File	Classification Change Lists	File classification change lists

TABLE C-4

PROCESSES FOR MICROCOPY PRODUCTION FROM MICROFICHE AND ROLL FILM BY MICROCOPY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Roll film and Form 0-8	Receive 100-ft roll film reels from Photography Section
2	Store	Roll film and Form 0-8	Store until needed
3	Transport internal	Roll film and Form 0-8	Carry film to work area
4	Splice	Roll film	Splice together a 400-foot roll of film for roll-to-roll duplication
5	Duplicate - roll-to-roll	Roll film	Duplicate roll film
6	Inspect	Roll film	Inspect duplicate roll for defects
7	Cut	Roll film	Cut duplicate roll into microfiche
8	Destroy	Microfiche	Destroy microfiche marked defective by film editors
9	Store	Microfiche	Store duplicate microfiche until needed
10	Pack	Roll film	Save one roll of duplicate film and store in film cans
11	Store	Roll film	Store one copy of roll film
12	Cut	Roll film	Cut up silver master into microfiche

TABLE C-4 (CONT'D)

Step	Process	Item Processed	Explanation
13	Sort	Microfiche	Sort microfiche into AD number order
14	Merge	Microfiche	Merge sets of microfiche from different film rolls
15	Store	Microfiche	Store microfiche until needed
16	Pack	Microfiche	Put each microfiche master into protective envelope
17	Group	Microfiche	Make up 15 microfiche TAB sets
18	Transport out	Microfiche	Transport oversize microfiche to bindery for cutting
19	Transport in	Microfiche	Receive microfiche back from bindery
20	Edit	AD number list	Mark off microfiche contained in TAB set on AD number list
21	Pack	Microfiche and AD number list	Pack shipments of microfiche for six field offices
22	Transport out	Microfiche and AD number list	Transport boxed microfiche to shipping area
23	Transport out	Microfiche	Transport one TAB set of microfiche to Film Library Unit
24	Inspect	Microfiche	Make out tracer list on missing microfiche
25	Transport out	Tracer list	Giver tracer list to Photography Section

TABLE C-4 (CONT'D)

Step	Process	Item Processed	Explanation
26	Look up	Tracer list	Look up and cross off microfiche received on list
27	Sort	Microfiche	Pull limitation-five microfiche from extension service shipment
28	Pack	Microfiche	Pack extension service shipment
29	Transport out	Microfiche	Transport microfiche to shipping area
30	Stamp	Protective envelopes	Stamp security classification on protective envelopes for microfiche
31	Transport out	Microfiche	Send eight copies of FAB sets to document storage

PROCESS ACTIVITIES	Roll Film	Microfiche	Form 0-8	Tracer List	Computer ADP List (14 copies)	Envelopes	Form-1
FILE			☒	☒	☒		
SORT		☒					☒
GROUP	☒	☒					
COPY			☒	☒			
PACK	☒	☒					
UNPACK	☒	☒					
MICROFILM							
TRANS-IN	☒	☒	☒	☒		☒	
TRANS-OUT	☒	☒					
TRANS	☒	☒	☒			☒	☒
COMPARE							
MATCH/MERGE							
MERGE		☒					
LOOK-UP			☒	☒			
RETRIEVE							
INSPECT	☒	☒		☒			
EDIT				☒	☒	☒	
PROCESS							
CUT	☒	☒					
SPLICE	☒						
FORMAT							
	☒	☒		☒	☒	☒	
	☒						
		☒					
		☒		☒			

☒ FREQUENT ☒ INFREQUENT

FILM PROCESSING SECTION
MICROCOPY UNIT

Figure C-10

After the roll film has been spliced in 400 foot rolls (step 4 of table), it is duplicated on the Tecnifax Hi-R roll-to-roll film duplicator at an average speed of 10 to 12 feet per minute. Approximately 3,000 feet or 6 copies of a single roll silver master can be duplicated and developed in an 8-hour shift.

For the most part, microfiche-to-microfiche duplication is performed only for request processing. Individual microfiche are duplicated on the CBS Model 601 microfiche-to-microfiche duplicator at a rate of 1,000 microfiche per day or on the Hi-R duplicator at a rate of 1,500 microfiche per day.

2.3.2.3 Cutting, sorting and collating

Roll film from the Microphoto Unit contains microfiche images in AD number order in more or less closed sequence. Some microfiche, however, are missing from a given sequence, and these will appear on subsequently received microfilm rolls. Document retakes out of numerical sequence will also appear either at the end of a film roll or within a roll devoted entirely to retakes. As microfiche are cut from a roll, they are stored in AD number sequence in boxes. After several rolls have been cut, microfiche from different rolls are merged to form a complete set of documents announced in one TAB issue. During the merging process (steps 13 and 14, Table C-4), any missing AD numbers are detected and noted on a tracer list (step 24) which is sent to the Photography Section. The Photography Section returns the tracer list with a notation next to some of the AD numbers to show the reasons why those particular microfiche are missing. Shipments of microfiche are held up as long as possible to include retakes indicated on the tracer list. For various reasons, some documents are not received by the Photography Section during a TAB cycle and do not appear on the 105 mm roll film. These documents represent a problem because a microfiche-sized card must be inserted in the appropriate place to indicate that the missing microfiche will be shipped later.

Although the cutting operation is straightforward, problems exist because of the variability of microfiche length. Bell & Howell microfiche cameras produce microfiche of 152 mm length, while the Microcard SR -1 cameras vary the size from 148 to 150 mm. If the microfiche is oversized, it must be cut in the bindery (step 18) in order to fit into protective envelopes. It is estimated that two-thirds of the microfiche must be trimmed down to size.

The Kodak Master Roll Paper Cutter, modified for microfiche, will cut automatically up to a 500-foot roll in approximately 30 minutes. At the conclusion of the cutting operation, defective microfiche marked by the film editors in the Photo Services Unit are discarded for destruction.

The set of microfiche to be delivered to the extension service at Redstone Arsenal must be culled to remove any documents falling in document distribution limitation Class 5 (step 27). Occasionally, selected microfiche must be removed from all TAB sets because of a change in distribution notice or security classification or because of cancellation.

2.3.2.4 Automatic distribution

At the present time, 16 full TAB sets of microfiche are being produced and distributed. The silver master roll cut into microfiche is sent to the film library unit. One set of diazo copies is distributed to each field office. Eight diazo sets are sent to document storage. One set, minus the limitation-five documents, is sent to the extension service at Redstone Arsenal. This accounts for 15 diazo copies and one silver master original. The 16th diazo copy is maintained in roll form to be placed in a depository for safekeeping against fire or other catastrophe. At the present time this roll of film is stored by the film library. NATO classified documents are not distributed automatically.

To accomplish automatic distribution, all microfiche recorded during a TAB cycle must be sorted in AD number sequence and inserted in protective envelopes stamped with the appropriate classification. All copies shipped outside of DDC must be accompanied by a check list showing the microfiche included. Form cards are inserted in the package of microfiche to indicate missing documents. Each card contains three comments -- (a) cancelled, (b) NATO deleted, and (c) will be shipped later -- and the appropriate comment is indicated. These cards are added after the tracer list has been circulated and checked.

2.3.2.5 Request processing

Sequential steps for request processing are presented in Table C-5. The most striking feature of request processing is the variation in the number of requests received from different organizations.

TABLE

REQUEST PROCESSING FOR OFICHE AND ROLL FILM ORDERS BY MI OPY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Microfiche or roll film and Form-1's	Receive film and Form-1's from Film Library Unit
2	Roll-to-roll duplication	Roll film	Duplicate required number of roll fil strips
3	Cut	Roll film	Cut up duplicate roll film
4	Pack	Roll film	Insert roll film strips into cassettes
5	Edit	Cassettes	Write AD number on cassette cover
6	Pack	Roll film	Pack cassettes for shipment
7	Transport out	Roll film	Transport shipment to shipping area
8	Microfiche-to-microfiche duplication	Microfiche	Duplicate microfiche orders
9	Pack	Microfiche	Insert microfiche into protective folders
10	Sort	Microfiche	Sort microfiche into user number order
11	Sort	Form-1's	Sort Form-1's into user number order
12	Pack	Microfiche	Pack microfiche and Form-1's into envelope
13	Transport out	Microfiche and Form-1's	Transport shipment to shipping area
14	Edit	Form 0-21	Check off complete orders on Form 0-21
15	Transport out	Roll film, microfiche and Form 0-21	Return film and Form 0-21 to Film Library Unit

Only ten organizations are currently ordering large volumes of microfiche. Within the top five companies, orders range from 300 to 2,000 microfiche per month; in the next five companies the range is from 200 to 300 microfiche per month; and below the top ten, orders are sporadic and unpredictable ranging from 1 to 200 microfiche per month. Requested microfiche are created by microfiche-to-microfiche duplication in all cases. The Microcopy Unit receives Form-1's to indicate which microfiche are to be duplicated. The Microcopy Unit inserts requested microfiche in a large envelope which is stamped with the classification of the highest classified microfiche contained. This envelope is, in turn, inserted in a larger envelope containing a window to receive the Form-1. Large shipments of microfiche are packed in the shipping room.

2.3.2.6 Hard-copy production from microfiche and 35 mm roll film

Refer to Figure C-11 for a matrix summary of processes and items processed, and to Tables C-6, C-7 and C-8 for sequential processing steps. The 35 mm film is spliced together in the film library and sent to the Full-Size Copy Unit which produces copies by xerography. If more than three copies of a document above a certain AD number are required, action is taken to prestock. Pre-stocking is accomplished by running the roll film on a paper offset master and printing multiple copies from the master. As a rule 25 copies are printed from each master. At the present time masters are made only from roll film. All documents recevied in less than three copies are automatically microfilmed on 35 mm roll film. Documents received in three or more copies are microfilmed on microfiche from which additional copies are obtained by sheet-by-sheet reproduction from the microfiche master held in the Film Library Unit. Document copies are side-stitched and packaged at the bindery.

2.3.2.7 Paper work controls

In each unit, statistics are maintained on the number of items entering the unit, the number of items leaving and the number of items processed each day. These statistics appear on control forms which enter the unit or are prepared in the unit, and on the Daily Production and Time Card filled out by each employee; they also appear in the summarization of these cards in intermediate records maintained by the unit supervisors and section heads and in the daily activity reports prepared by the branch chiefs. Thus, a

PROCESS ACTIVITIES	Form-1	(Film Processing Record) Form 0-21	Microfiche	Documents	Document Cases	Form 0-110	Raw Paper	Roll Film	Multilith Masts									
[illegible]						X												
[illegible]																		
GROUP				X					X									
COPY		X				X												
PACK		X	X					X	X									
UNPACK		X	X					X										
MICROFILM																		
TRANS-IN	X	X	X		X		X	X										
TRANS-OUT	X	X	X					X	X									
TRANS	X	X	X					X	X									
COMPARE	X	X																
MATCH/MERGE																		
MERGE																		
LOOK-UP																		
UNCREEVE		X																
INSPECT																		
[illegible]																		
PROCESS																		
CUT																		
SPLICE																		
FORMAT																		

X FREQUENT X INFREQUENT

FILM PROCESSING SECTION
FULL SIZE COPY UNIT

Figure C-11

TABLE C-8

PROCESSING STEPS FOR PRODUCTION OF FULL-SIZE COPY FROM ROLL FILM BY FULL-SIZE COPY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Form-1 Roll film (100feet), empty cassettes and Form 0-21	Receive 100-foot microfilm rolls from Film Library Unit
2	Store	Form-1 Roll film (100 feet), empty cassettes and Form 0-21	Store roll film at supervisor's desk
3	Transport internal	Form-1 Roll film (100 feet), empty cassettes and Form 0-21	Carry film to work station
4	Store	Form-1 Roll film (100 feet), empty cassettes and Form 0-21	Store film at work station
5	Unpack	Form 0-21 and film	Take Form 0-21 and roll film from envelope
6	Look up	Form 0-21	Look up screening and copy requirements on Form 0-21
7	Enlarge/print	Roll film	Produce full-size hard copy from roll film
8	Inspect	Documents	Examine quality of hard-copy output
9	Pack	Form 0-21, Form-1 and documents	Detach hard-copy output in roll form and insert Form 0-21 and Form-1
10	Pack	Form 0-21 and roll film	Place Form 0-21 and microfilm roll in envelope

TABLE C-6 (CONT'D)

Step	Process	Item Processed	Explanation
11	Store	Documents, Form 0-21 and Form-1's	Store hard copy of documents in roll form for pickup
12	Store	Roll film and Form 0-21	Store roll film for return to film library
13	Transport out	Hard-copy document roll, Form-1's and Form 0-21	Transport hard-copy document roll to bindery
14	Transport out	Roll film and Form 0-21	Transport roll film to Film Library Unit
15	Transport internal	Form 0-21	Carry Form 0-21 to supervisor's desk
16	Copy	Form 0-21	Copy production statistics to Form 0-110
17	Store	Form 0-21	Store Form 0-21 for one week
18	Transport out	Form 0-110	Deliver Form 0-110 to branch chief
19	Destroy	Form 0-21	After one week, destroy Form 0-21's

TABLE C-7

PROCESSING STEPS FOR PRODUCTION OF FULL-SIZE COPIES FROM MICROFICHE BY FULL-SIZE COPY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Form-1, microfiche and Form 0-21 (3 copies)	Receive envelope from Film Library Unit
2	Store	Form-1, microfiche and Form 0-21	Store envelopes on unit supervisor's desk
3	Transport internal	Form-1, microfiche and Form 0-21	Transport envelopes to copy production station
4	Store	Form-1, microfiche and Form 0-21	Store envelopes at copy production station
5	Unpack	Microfiche and Form 0-21	Remove microfiche and Form 0-21 from envelope
6	Lookup	Form 0-21	Look up copy and screening requirements on Form 0-21
7	Unpack	Microfiche	Remove microfiche from protective envelope
8	Enlarge/ Print	Microfiche	Produce full-size copy from microfiche
9	Inspect	Documents	Inspect quality of reproduced documents
10	Edit	Form 0-21	Check off completed work on Form 0-21

TABLE C-7 (CONT'D)

Step	Process	Item Processed	Explanation
11	Group	Documents	Insert cover sheet between documents
12	Pack	Documents	Attach front and back covers to classified documents
13	Pack	Microfiche	Put microfiche in protective envelope
14	Pack	Microfiche and Form 0-21	Wrap form around microfiche and band
15	Pack	Form-1 and Form 0-21	Put Form-1's and copy of Form 0-21 in pre-numbered envelopes
16	Pack	Form-1 and Form 0-21	Put pre-numbered envelope in box with documents
17	Store	Form-1, Form 0-21 and documents	Store box of documents
18	Store	Form 0-21 and microfiche	Store microfiche and Form 0-21
19	Transport out	Form-1, Form 0-21 and documents	Transport reproduced documents to bindery
20	Transport out	Microfiche and Form 0-21	Transport microfiche and Form 0-21 to Film Library Unit
21	Transport internal	Form 0-21	Carry Form 0-21 to supervisor's desk
22	Copy	Form 0-21	Transfer production statistics to Form 0-110

TABLE C-7 (CONT'D)

Step	Process	Item Processed	Explanation
23	Store	Form 0-21	Save Form 0-21 for one week
24	Transport out	Form 0-110	Deliver Form 0-110 to branch chief
25	Destroy	Form 0-21	Destroy accumulated Form 0-21's

PROCESSING STEPS FOR THE PRODUCTION OF PAPER OFFSET PLATES FROM ROLL MICROFILM BY FULL-SIZE COPY UNIT

Step	Process	Item Processed	Explanation
1	Transport in	Form-1 and Form 0-21 or paper offset plate work order plus roll microfilm	Receive roll microfilm and forms from either Film Library Unit or Photo Services Unit
2	Store	Form-1 and Form 0-21 or paper offset plate work order plus roll microfilm	Store at unit supervisor's desk
3	Transport internal	Form-1 and Form 0-21 or paper offset plate work order plus roll microfilm	Transport to work place
4	Store	Form-1 and Form 0-21 or paper offset plate work order plus roll microfilm	Store at work place
5	Unpack	Roll film and forms	Remove roll film and Form 0-21 or work order from envelope
6	Lookup	Form 0-21 or work order	Look up screening requirements
7	Enlarge/print	Roll film	Produce paper offset plate from microfilm
8	Inspect	Paper plates	Inspect quality of image on paper plates
9	Pack	Roll film and Form 0-21 or work order	Put roll film and forms in envelope

TABLE C-8 (CONT'D)

Step	Process	Item Processed	Explanation
10	Pack	Paper plate master	Wrap forms into paper plate master roll
11	Store	Paper plate master roll	Store masters for pickup by bindery
12	Store	Roll film	Store microfilm for pickup by Film Library Unit
13	Transport out	Roll masters	Deliver roll masters and forms to bindery
14	Transport out	Roll film	Deliver roll film to Film Library Unit
15	Transport internal	Form 0-21	Deliver Form 0-21 to supervisor
16	Copy	Form 0-21	Copy production statistics to Form 0-110
17	Store	Form 0-21	Store Form 0-21's at supervisor's desk
18	Transport out	Form 0-110	Deliver Form 0-110 to branch chief
19	Destroy	Form 0-21	Destroy accumulated Form 0-21's

particular statistic might appear in as many as five different places as it is copied from form to form.

Major record keeping is involved in the control of document flow from unit to unit. All documents received for microfilming are logged in on a hand-prepared log sheet. Concurrently documents received are checked off on a computer printout of AD numbers supplied by the Technical Services Branch with each shipment of documents. As documents are microfilmed, the document AD number, classification, and number of microfiche produced are marked on a camera operator's filming list (DDC Form 0-8). This form also contains the camera number, date of filming, camera operator, film size, reel number, batch number, document type, and type of action (i. e., errata, retakes, reclassification, or targets only). As each reel of film is completed in the camera, the reel number, camera operator, date reel inserted in camera, date and time reel removed from camera, and reel classification are recorded on a film log sheet. As the film is inspected defective microfiche are marked on a retake sheet which specifies the AD number, document classification, number of microfiche and reasons for retake.

The DDC Form 0-8 accompanies the inspected roll film to the Microcopy Unit where the roll film is duplicated in 13 copies. The number of the roll on which input documents were recorded is copied to the Film Processing Section log book. In the course of cutting duplicate rolls, the Microcopy Unit prepares the tracer list which is circulated back to the Microphoto Unit to check on missing microfiche. A line under an AD number on Form 0-8 indicates that the corresponding microfiche is defective and that steps will be taken to refilm the document. The Microcopy Unit also receives a listing of all AD numbers announced in the current TAB issue. This list is duplicated 14 times, and a single TAB set of microfiche is inventoried against one copy of the list. The check marks next to each AD number represented by a microfiche in the TAB set are transferred to all 14 copies of the AD number list. Two copies of the list are included with each of the six shipments of microfiche to the field offices. Two copies are sent to the storage area, and the original is sent to the shipping room.

The Film Library Unit fills out a DDC Form 0-21, Film Processing Record, for each batch of documents ordered by Form-1. The AD numbers of requested documents are listed on the Form 0-21 with an indication of the number of copies required of each document and the screening requirements for processing half

tones. This form accompanies microfiche or microfilm pulled from the files and sent to either the Full-Size Copy Unit or the Microcopy Unit. Form 0-21 acts as an inventory list for checking off film returned by the two copy units. Data is also extracted by the copy units and merged with other production statistics which are included in the daily activity reports.

2.4 Equipment

Equipment operated in the Photographic Branch is listed in Tables C-9 through C-12.

2.4.1 Cameras

The Microphoto Unit has seven microfilm cameras. Six of these are 105 mm step-and-repeat cameras for production of microfiche on roll film, and one camera is a Bell & Howell MRD-2 Planetary 35 mm camera. Four of the step-and-repeat cameras are Microcard SR-1's, and two are Bell & Howell Microdata cameras.

The step-and-repeat cameras have some difficulty in maintaining a uniform advancement so that microfiche are not of uniform length. The Microcard SR-1 cameras sometimes do not index each frame completely so that some frame overlap exists. A second MRD-2 35 mm camera exists in the Printing Branch and is sometimes used to absorb part of the 35 mm roll film workload.

2.4.2 Binding and binding-removal equipment

Binding machines and power knives are located primarily in the Printing Branch, but the Microphoto Unit is provided with some light equipment for removing document bindings and for rebinding. The Microphoto Unit has both a Bostitch stapler and a plastic comb inserter for rebinding. The power knife at the bindery must be used for removing heavy bindings. Side-stitched and saddle-stitched bindings can be removed at the Microphoto Unit with pliers and wire-cutters.

TABLE C-9

EQUIPMENT IN MICROPHOTO UNIT AND PHOTO SERVICES UNIT

Manufacturer	Model	Units	Function	Machine Production Rate	Operator Production Rate
Microcard	SR-1	4	105 mm step-and-repeat camera	--	--
Bell & Howell	Microdata	2	105 mm step-and-repeat camera	--	--
Bell & Howell	MRD-2	1	35 mm camera	--	--
Bostitch	EHFS	2	Stapler	--	--
Neumade	--	2	Motorized rewind	--	--
Idealite	--	3	Light table	--	--
Remington Rand	Unipro	1	Film processor	3.7 ft/min	--
Recordak	CP-105	1	Card-to-roll printer	--	--
Recordak	CP-105R	1	Roll-to-roll printer	--	--
Densicron	--	1	Densitometer	--	--
--	--	1	Microscope	--	--
General Binding	--	1	Binder	--	--

TABLE C-10

EQUIPMENT IN FILM LIBRARY UNIT

Manufacturer	Model	Units	Function	Machine Production Rate	Operator Production Rate
Microcard	Mark 4	1	Reader	--	--
Diebold	Flowfilm	1	Reader	--	--
Colight	--	1	Kalvar duplicator	--	--
Prestoscal	--	3	Splicer	--	--
--	--	1	Manual rewind	--	--

TABLE C-11

EQUIPMENT IN MICROCOPY UNIT

Manufacturer	Model	Units	Function	Machine Production Rate	Operator Production Rate
Tecnifax	High-R	1	Diazo roll-to-roll duplicator	10 to 12 ft/min	6.2 ft/min
Kodak	Master roll paper cutter	1	Microfiche cutter	16.7 ft/min	--
CBS	601	1	Microfiche-to-microfiche duplicator	4 ft/min	1000 microfiche/day
Ozalid	Microline FP-2	2	Roll-to-roll duplicator	--	--
Neumade	--	3	Film rewinder	--	--

TABLE C-12

EQUIPMENT IN FULL-SIZE COPY UNIT

Manufacturer	Model	Units	Function	Machine Production Rate	Operator Production Rate
Microcard	EL-4	6	Enlarger printer	6 pages/min	4.1 pages/min (2000 pages/8-hr. shift)
Xerox	Copyflo	3	Enlarger printer	48 pages/min (40 ft/min)	35.4 pages/min (17,000 pages/8 hr. shift)
--	--	1	Motorized film rewind	--	--
--	--	1	Vacuum cleaner	--	--

2.4.3 Film processing and inspecting equipment

All film processing and inspection equipment is located in the Photo Services Unit. A Remington Rand Unipro Film Processor is used for developing 105 mm and 35 mm microfilm.. A Densicron densitometer is used for measuring the background density of developed microfilm, and a microscope is used for checking resolution. Three Idealite light tables are available for gross inspection of microfilm and microfiche.

2.4.4 Film duplication equipment

The Microcopy Unit uses a Tecnifax Hi-R duplicator and two Ozalid Microline FP-2 units for roll-to-roll duplication of microfilm. The Tecnifax Hi-R duplicator can also be operated in a sheet-to-roll duplication mode, but this use is infrequent. One CBS Model 601 microfiche-to-microfiche duplicator is used for satisfying microfiche requests. All 105 mm roll film is cut to microfiche size on a Kodak master roll paper cutter. The Microcopy Unit also uses three Neumade film rewinders.

2.4.5 Cutting and splicing equipment

The Film Library Unit has the heaviest cutting and splicing operation. Three Prestoseal splicers are used for cutting and splicing microfilm. A Microcard Mark 4 or Diebold Flowfilm reader is used for film inspection. One manual rewind is available for winding roll film. Some splicing is done in the Photo Services Unit, but this is accomplished with tape or staples.

2.4.6 Hard-copy enlargement equipment

Three Xerox Copyflo machines and six Microcard EL-4 enlarger/printers are used for obtaining hard copy. The Microcard equipment produces full-sized copies from microfiche at the rate of six pages per minute. The Copyflo machines produce continuous roll hard-copy at the rate of 40 feet per minute or 48 pages per minute. The Copyflo equipment can also be used for obtaining Xerox offset masters. Offset masters cannot be produced on the Microcard equipment.

3. EVALUATION OF PRESENT CAPABILITIES

The previous subsections provide a descriptive review of the present DDC operations related to micrographics. Evaluation of DDC capabilities for carrying out these operations is interpreted as a requirement to be met by this study in two ways:

(a) Evaluation of present capabilities to carry out present operations.

(b) Evaluation of present capabilities to carry out future or projected operations.

The former is considered immediately below; the latter has been taken into account in the buildup of the five-year development action plan under Section F.

3.1 Criteria Chosen for Evaluation

An evaluation of present capabilities is most effectively done on the basis of comparing present methods, equipments, and materials used against alternatives. Important criteria for comparative evaluation have been considered to be:

(a) Quality of user services

(b) Operating cost

(c) Investment cost

(d) Manpower required

(e) Capacity for evolutionary system growth

(f) Compatibility

3.1.1 Quality of user services

The end-point objective of all DDC operations is to provide effective information services to its users. A contrast in quality of user services among alternatives is considered unless there are ample offsetting factors.

3.1.2 Operating cost

This is considered the most tangible and major factor in evaluating alternatives.

3.1.3 Investment cost

This includes all tangible costs, e.g., installation, start-up and purchase cost elements, plus consideration of peripheral investment costs if changes were to be made.

3.1.4 Manpower required

Both personnel count and skill level required by the alternatives considered are presented.

3.1.5 Capacity for evolutionary system growth

This point of comparison is particularly important at this time because of expected future changes in service concepts and volume of material to be handled.

3.1.6 Compatibility

This is important as it identifies the ability of any particular alternative method to work into larger scale Federal system requirements.

3.2 Matrix Displays of D&I Items and Process Activities Evaluated

Figure C-12 presents a matrix listing of all significant current D&I items and the process steps through which they now flow. The present DDC organizational unit in which the process activities are performed is also identified. Entries for headings on both rows and columns have been selected from the more embracive matrix displays of Section C.2. Figure C-12 identifies those D&I items and process step intersections which warrant examination of alternatives. The display of alternative comparisons appears in chart form in Figure C-13. Each entry is keyed back to the matrix entry of Figure C-12 (see legend on Figure C-12).

...s ...ies	Technical reports - Hardcopy 8-1/2 x 11 (approx.)				Technical reports - Hardcopy 11 x 14 (approx.)				Reprint articles & technical papers				Pamphlets				Book form indexes				Charts, graphs, & drawings				IDEP reports				Computer listings				Libr...			
	50,000/ year				2,000/ year				Low/yr.				2,500/ year				Low/yr.				Part of reports				1,800/ year				Part of reports				Pa re			
...on Unit	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F
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Now handled only as pages of technical reports

Now handled only as pages of technical reports

Now handled only as pages of technical reports

Great Mandatory

9				10				11				12				PRODUCED D&I ITEM HANDLING 13				14				15				16			
4 x 6 microfiche (used as masters)				Bibliographic lists				35 mm roll film (used as masters)				Camera ready copy for "Tab" products				Duplicate copies-hardcopy reports				Duplicate copies-microfiche				Computer listings							
												24 issues												24							
P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F	P	L	M	F
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NOTES:

1. P = Photography section
   L = Film library unit
   M = Microcopy unit
   F = Full size copy unit
2. Where the symbol appears
   = see comparison chart
3. = Activity without significant alternatives to compare
4. Key to chart uses a compo[illegible] notation, e.[illegible]
   P - 7/h.
   P = Photo[illegible] unit
   7 = D&I [illegible]
   h = proce[illegible] ter in[illegible]

SUMMARY [illegible]
PRESENT [illegible]
[illegible]

SUMMARY EVALUAT
MICROGRAPHIC

OPERATION	ALTERNATIVES	QUALITY OF USER SERVICES	COST COMP	
			Operating	I
Photography Section Handling & preparation of Incoming D&I Items (exclusive of microfilm camera operation)				
Clerical operations now performed in total or in part by the photography section camera operator personnel accounting for approximately 25% of time	Clerical, handling & D&I preparation operations could be performed by a separate group of clerical-type personnel	Higher quality fiche should result due to consistent document preparation before receipt at camera; camera operators attention can be focused on the optimization of graphic image as well as increasing output rate	Slight reduction	
Microfiche Production				
Microfilming	Elimination of all operations not concerned with actual D&I filming. Establish routines for filming preventive maintenance, etc.	Should result in speed up of output from present cameras & improve general quality of photography	None	
Inspection [illegible]	Design inspection [illegible] for the handling of 105mm [illegible] institute and follow formal procedures [illegible]	Overall quality level [illegible] improve [illegible] overall [illegible] of [illegible] filming	Reduced	

TION OF PRESENT
: OPERATION

PARISON nvestment	MANPOWER REQUIRED	CAPACITY FOR EVOLUTIONARY SYSTEM GROWTH	COMPATIBILITY	NOTES
[illegible]	Additional 2 females 1 male (WB-7)	Improvement in camera operations should increase output from present norm of 2500 exposures to at least 3500 exposures	N/A	D&I preparation workplace should be separated from, but contiguous to, camera workplace. Physical layout should be based on material flow (IN & OUT)
[illegible]	None	(See above) [illegible]	N/A	Time loss due to operator distance [illegible] reduced by [illegible] of work [illegible]
[illegible]	[illegible]	[illegible]	N/A	[illegible]

	OPERATION	ALTERNATIVES	QUALITY OF USER SERVICES	COST COMP	
				Operating	In
P-1	Microfiche Production (Cont'd)				
P-3					
	Processing (silver film)	Institute quality control procedures (e.g., control strips, etc.) & maintain standard darkroom practices (cleanliness, etc.)	Maintain consistent level of quality in output by identifying specific equipment or processes which may be contributing to quality reduction	Reduced	
	Duplicate Copy Microfiche Production - Controlled [illegible] - (approximately 2/3 of full fiche [illegible] size)	Support design of high-speed cutting equipment (e.g., flexible angle blades to control size). Should have manual operation override	N/A	[illegible]	
	Present operations [illegible] for cutting [illegible]	Eliminated by [illegible]	N/A	[illegible]	
	[illegible]	[illegible]	N/A	[illegible]	

COST COMPARISON		MANPOWER REQUIRED	CAPACITY FOR EVOLUTIONARY SYSTEM GROWTH	COMPATIBILITY	NOTES
Operating	Investment				
educed	Minimal	Additional 1 - GS-7	Higher processing productivity & improved quality	N/A	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	None	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]			

	OPERATION	ALTERNATIVES	QUALITY OF USER SERVICES	COST COM
				Operating
[illegible]	Hard Copy Generation Roll Film Present operation - using Xerox Copyflo equipment Requires the splicing of reports together to fill up 100 ft. rolls - also requires grouping according to production requirements - also requires cutting strips apart upon completion of effort	Support design modification to existing equipment to allow feeding of individual film strips - self threading - automatic stop on completion of each strip	Improved hardcopy since copy from each report film strip could be checked upon completion of each film strip duplication	Lower
[illegible]	Duplicate Copies - [illegible]			
[illegible]	[illegible]	Support [illegible] existing equipment	[illegible]	[illegible]

A

COST COMPARISON		MANPOWER REQUIRED	CAPACITY FOR EVOLUTIONARY SYSTEM GROWTH	COMPATIBILITY	OTHER
erating	Investment				
ower	≤ 50K	Reduced requirements eliminates approximately 25% of present film library workload	Reduce throughput time	N/A	
[illegible]	≤ [illegible]	[illegible]	[illegible]	N/A	

The display of D&I items and process activity steps in matrix form is used in later sections of this report as a basic tool for furthering the analysis and ultimately the synthesis of the Five-Year Plan of Development Actions. It provides a method for conducting a penetrating and detailed analysis at the level which actually determines production technology requirements and the feasibility of using alternative equipment materials and methods. At the same time, the matrix of detail is handled as one element as the study development moves logically from an evaluation of present capabilities into the subsequent steps of (1) projecting future system requirements, (2) evaluating the feasibility of alternatives, and (3) synthesis of the resultant recommended capability and associated development action plans to produce it.

Several D&I items listed now have negligible flow levels in DDC operations but have been included in Figure C-12 to enable direct comparison to projected possibilities presented in the subsequent Section D. In the past, DDC's operations have handled some of the items now considered negligible. Flow rates shown are estimates of the current handling flow rates as of July 1966.

D. ALTERNATIVE OVERALL SYSTEM CONCEPTS AND FUTURE POSSIBLE DDC MICROGRAPHIC CAPABILITY NEEDS

1. INTRODUCTION

Planning the DDC Development Actions necessary over the next five years to develop future micrographic capabilities requires that the following steps be carried out:

(a) Review overall RDT&E/DOD STINFO Service System plans.
(b) Identify the future constituent service concepts that are candidates for inclusion in the overall STINFO Service System plans for the five-year period.
(c) Identify the data and information (D&I) items and process steps needed to provide these services.
(d) Identify the production capability required to process D&I items at each step.
(e) Identify the technology required at each step.
(f) Identify the technology already available or under current development by others.
(g) Select the critical areas for DDC Development Actions in order that the desired set of equipment, materials, methods and procedural capabilities will be available at the right time throughout the five-year period.

Each of these steps is considered important and has been pursued under this study.

1.1 Review of Overall RDT&E/DOD STINFO Service System Concept

There have to date been no large scale integrated RDT&E/DOD STINFO Service System plans approved for operational implementation. However, a number of related programs have been undertaken: (1) On-Site Survey of STINFO Functions and Activities throughout U. S. Army; (2) DOD User Need Study investigating information use patterns of personnel within RDT&E; (3) DOD User Need Study investigating information use patterns among personnel in contractor organizations; (4) partial completion of the EDIS Project to develop an engineering data and information system for the U. S. Army; (5) Army Technical Library Improvement Studies (ATLIS) program; and (6) Survey of the Use of Automated Library Techniques in DOD Technical Libraries. These

and other programs provide only the initial insight from which to build future STINFO Service System plans.

Because of the unavailability of comprehensive RDT&E/DOD STINFO Service System plans which were desirable as a starting point for the five-year DDC planning study to develop future micrographic capabilities, IDC has hypothesized a set of alternative concepts. These were based on an examination of current thinking in the field with particular emphasis given to the series of studies now being sponsored by DOD. Out of the alternative system concepts considered, constituent service possibilities were identified that could impact on DDC's future requirements.

1.2 Future Constituent Service Concepts

Future DDC requirements for micrographic capabilities will be established as a direct result of decisions to provide specific constituent STINFO System services. In addition to present service activities, it is expected that during the projected five-year period new service concepts will be implemented. Although this study has no authoritative base for identifying future new services to be provided, a set of additional services of possible future interest to the RDT&E community has been selected from the overall STINFO Service System concepts considered in Section D-2. Several of these services would result in additional production loads and the need for additional micrographic capabilities at DDC.

1.3 Identification of D&I Items and Process Steps Needed to Carry Out Services

Micrographic capabilities for DDC are to be used for the production and handling of graphic records which carry data and/or information. A fundamental need, therefore, is to identify all D&I items which are candidates for the application of micrographic media. The process steps through which D&I items flow determine the specific first points of entry of the use of micrographic media and the types of media that can be most advantageously used.

The analysis proceeds below on the assumption that D&I items and process steps can be identified for the projected five-year period by combining current service operations with those identified as new service concepts to be added to DDC work load in new overall system operations.

1.4 Capabilities Required To Process D&I Items

Any D&I item is defined by a unique combination of image format(s) and record media as it enters a process. As hard-copy technical reports are received and made ready for microfilming, for instance, it is important to make the distinction between 8-1/2 by 11 and 8-1/2 by 14 D&I items. It is also important in microfilm camera operation to distinguish between 8-1/2 by 11 technical reports and 8-1/2 by 11 technical paper reprints or journal articles.

Capabilities are defined here as a collection of equipment, materials, methods, and procedures adequate to meet the specific requirements of the process step as it operates on the D&I item(s). After the analysis proceeds to the point of identifying constituent D&I items and process steps, the required production capabilities then identify the need, if any, for incorporating new technology, over and above that now available at the DDC facility.

1.5 Appraisal of Technology Required for Individual Processes

At each step in the process of handling D&I items this study asks the question: "Is there an application for micrographics in this operation?" If so, note is made of the volume of flow, the format of the D&I item, and other characteristics significant to the selection of technology suitable for carrying out the process step. In analysis steps detailed below, this is the procedure used to pin-point requirements for improving or adding to facility capabilities.

1.6 Identification of Technology Already Available

After identifying the required processing capabilities, a determination is made of the availability of technology now utilized within DDC operations or available to DDC directly from suppliers or under development through the work of others (e.g., Government agencies). This step is supplemented by a state-of-the-art review with specific attention on micrographic equipment, materials and techniques as they might apply to both present and future areas of applications within DDC. The results of this review appear in Part III of this report. A description of the technology already available within DDC operations is given in Section C, Part II.

1.7 Selection of the Critical Areas for DDC Development Action

The technique for analysis used in this planning study provides a means for highlighting specific process technology required. The technique traces these requirements to the original STINFO service concepts, thereby allowing selection of required technology on a priority basis depending upon the relative likelihood or timing sequence of introducing new service concepts. When combined with such limiting factors as manpower and financial budgets, this provides a sound and penetrating basis for selecting the critical areas for DDC Development Action.

As each DDC process capability is selected for inclusion in the five-year plan, the projected capability makes additional service activities possible. Thus, there is room for synthesis in construction of the plan to implement DDC Development Actions in such a way as to maximize the DDC facility capability of responding to future needs for both identified and unidentified STINFO services.

1.8 Methodology Chosen for Analytical Structuring of Planning Steps

The detailed analysis presented below makes extensive use of matrix displays. This method of analysis permits a relatively simple conceptual flow for the study while analyzing applications that are responsive to specific service concepts. The analysis lacks, however, authoritative projections of future specific STINFO system activities responsive to user needs.

The use of matrixes has been further extended in synthesizing the recommended Development Action plan. Details of the matrixes have been retained in presenting the plan in order that a maximum degree of future flexibility is provided for modifications and updating of the plan. The method is highly recommended for future use at DDC both in program analysis and synthesis steps. As future service system needs crystallize and other changes occur, the plan now presented will require adjustment.

2. SUMMARY OF MAJOR ALTERNATIVE OVERALL DOD/RDT&E STINFO SERVICE SYSTEM CONCEPTS

2.1 Introduction

The Department of Defense expended $7 billion in the RDT&E (Research, Development, Test and Evaluation) effort in FY 1964; 36,000 scientists and engineers were involved. DOD, the nation's largest sponsor of research and engineering, is highly justified in its endeavor to improve the methods by which STINFO is acquired, processed, packaged, disseminated and used. The design and successful implementation of an effective RDT&E STINFO system within DOD could revolutionize the methods of every scientist and engineer. An effective RDT&E information management system will not ensure positive results from the RDT&E effort; however, absence of a comprehensive information management system can be significantly detrimental to the efficiency and probability of success of the DOD/RDT&E programs.

One need not be perceptive to conclude that the information problem is immensely complex. However, the problem is by no means insurmountable. By recognizing that the information problem is actually a multiplicity of interacting problems to which there is no single, simple, all inclusive answer, by tying together the tremendous variety of existing information resources into logical patterns, and by solving the constituent problems one at a time, a powerful framework can be constructed to satisfy the DOD/RDT&E STINFO needs.

The ensuing discussion attempts to prognosticate the probable direction in which solutions to the DOD/RDT&E STINFO problems may evolve during the next five years (1967-1971). Many previous studies of this kind have done a fine job of stating the problems; few allude to anything substantial or specific toward solution of these problems. This study attempts to offer some system design requirements and specific methodology toward solution of the overall DOD/RDT&E STINFO problem.

It must be stressed, however, that the analysis below is not a comprehensive and exhaustive engineering analysis of the total problem. The conceptualized system designs presented must be considered as first-cut suggestions of possible and logical approaches to solving the multitude of DOD/RDT&E STINFO problems.

2.2 Need for System Design Guidelines

There is a fundamental need for the establishment of formal system design guidelines in advance, especially in the context of a proposed system design involving the immensely complex DOD/RDT&E STINFO problems. Currently these official guidelines do not exist in explicit terms. Therefore, in order to establish possible system concepts and to determine the role that DDC might play in the evolution of a total information management system within DOD during the next five years, it becomes necessary to make an attempt at establishing such guidelines.

Designing a solution to the DOD/RDT&E STINFO problems must involve a systematic analysis and organization of imaginative ideas, control methods, operating procedures, inter-and intra-system interactions, information sources, information recipients, physical items, personnel, hardware, software and other elements designed and interrelated in such a way as to perform the desired functions. There will be no attempt in this report to produce comprehensive and formalized system criteria and design requirements based on established engineering principles of synthesis and analysis. However, it is appropriate to list some basic precepts which any DOD/RDT&E STINFO system design must take into consideration if it is to be successful.

System design guidelines are presented below as overall criteria statements governing basic requirements which any system must satisfy if it is to work at all within the RDT&E environment. Some of these statements appear so basic as to be naive; however, they are actually the cornerstones upon which the implemented system will succeed or fail. Each of the following seven criteria constitutes an essential building block of the framework within which any effective DOD/RDT&E STINFO system must operate:

2.2.1 Evolution

It is doubtful that any one person (or group) has an absolutely clear picture of the current and future information needs of the scientists and engineers within DOD. The perfect system cannot, and need not, be designed at the onset. The continued operation, successive feedback and evolutionary improvement of the system is the obvious course to follow. Furthermore, experimental and exploratory systems designed to solve immediate, but smaller scale, problems should be built; it is from these prototype systems that effective large scale systems will evolve to solve the DOD level, and even the national

level, problems.

There is acute awareness that an improved information system will require more than further extensions and improvements of traditional library tools and techniques. However, the establishment of system concepts and the eventual implementation of a total system must be accomplished in an evolutionary manner, having minimum interference with current activities. The development must initially make the most practical use of existing facilities and resources. The entire library profession, documentalists, systems engineers and potential users must all work in harmony for a considerable period of time in evolving a new total system to solve the DOD/RDT&E STINFO problems.

There is an additional aspect to the concept of system evolution. In order for the ultimate system to achieve maximum value to the community using it, it must be "self-adaptive", where the system continuously adjusts itself to the environment. In the context of an information system, it means the system will actively and continuously incorporate additional data (to clarify and/or amplify existing information) and require the addition of new categories of data (responsive to the frequency of user requirements for information). This concept, although somewhat abstract and "far off", is an essential element to a fully implemented successful system. It may not be a mistake to consider such system extensions at the outset and make appropriate provisions at an early design stage.

2.2.2 Conceptual dichotomy

The overall system concept must look at the RDT&E STINFO problem as consisting of two separate elements which may or may not be mutually exclusive. These elements are IS&R (information storage and retrieval) and DS&R (document storage and retrieval). The first category involves a confluence of information evaluation and retrieval elements. IS&R would deal with the specific contents of documents in terms of their breakdown into numerous modes of identification. It would also deal with the physical location(s) of the document itself. The second categorization involves the actual document as well as other document-oriented elements, including publication, document accession, storage and dissemination.

Normally, the information-oriented activities concern themselves with current awareness, analysis and evaluation, retrospective searches and corollary functions such as abstracting and

indexing. The IS&R functions are particularly identified with the needs of RDT&E programs for information currently not being fulfilled. The DS&R functions are centered on the library, depository and publication functions.

Whether or not the IS&R and DS&R functions are performed by the same organization, or take place at the same physical location, is irrelevant to the concept of breaking up the overall problem into two major areas--information management and document management. It is believed that, by approaching the problem in this way, the complexity of the problem and the difficulty in determining a solution are significantly reduced.

2.2.3 Communication of information

There must be systematic, deliberate and willing communications between user organizations in order to foster a dynamic system. This statement refers to communication of information and not documents. The existence of every document plus knowledge of its contents and location must be made known to the system. However, distribution of every document need not be made to the depository if the originator wishes to maintain firm control over its dissemination and exercise final decision rights as to who may receive it.

2.2.4 Specificity/selectivity

Any system that provides a "truckload" of response to every query is doomed to failure. Furthermore, most scientific and technical personnel cannot even keep up with literature in their field; documentalists are also having significant problems in managing the growing volume of information. A major step in the solution of these problems is the requirement that users be more selective in their information intake. The basic requirement is to channel timely and pertinent information to interested personnel as efficiently as possible.

It appears that of equal importance to the technical content (i.e., does the material provided satisfy the request) is the question of volume. No matter how well the request for specific literature has been fulfilled, very few engineers or scientists will be willing (or will have the time) to pore through a mountain of material. The recipient must be made aware of the volume he will receive on the basis of his query and, if excessive, he must be more specific and resubmit his query. In short, there must be a built-in requirement for a degree

of specificity to provide not only the quality desired but also a realistic quantity.

In addition to more specificity with respect to responsiveness of requested information, there is also a question of automatic selective dissemination of information. There is an acute requirement, currently, for a much higher degree of selectivity in this area of service to the user. In short, the breadth of the selectivity is often so wide as to cover far more information than is desired or needed.

There are other ways to cut down the volume of information transmitted to the user besides an attempt to reduce the number of documents. For example, the document can be "cut up" in such a way as to provide the user with only that portion he needs. This approach, called segmentation, will be discussed in detail below. Another method of decreasing the number of documents requested is to convey to the user a better understanding of the contents of the documents before the ordering takes place. Various methods of accomplishing this difficult task are explained below.

2.2.5 Information management

It is very important to realize that the solution to the technical information problem principally involves the implementation of an effective information management system. This terminology does include both the information and document storage and retrieval elements stated in paragraph 2.2.2 above. However, the emphasis is on the management of information - not documents as it is in the standard library approach. The effective management of RDT&E information is a key factor in design of the problem solution. The conventional library approach has not and cannot solve the DOD/RDT&E STINFO problems.

Major elements of the information management approach concern the two questions of information interchange and physical media of transmission. Although the system will primarily serve the RDT&E area, the D&I required for RDT&E engineering effort is not confined to D&I generated specifically within the RDT&E area. As pointed out in a previous section, there is considerable information interaction between RDT&E and I&L.

The DOD User Needs Study has concluded that "the most frequently used category of information can be termed 'engineering data,' particularly the class entitled performance characteristics and specifications (42 percent)." Subsequent investigations have indi-

cated that in some organizations as much as 75 percent of the data used is engineering-type data. The underlying point here is that the system, in order to be truly useful, must cover more than just technical reports and journal articles. Engineering-type data is most often contained in specifications, drawings, test reports, parts lists, component reliability surveys, etc. A system encompassing only technical reports would solve only a small part of the overall RDT&E STINFO problems.

2.2.6 Identification modes

The proposed system must be user-oriented. Requirements for information by the participants must be used as major guidelines in development of this information system. Although D&I of an engineering nature can usually be classified under a specific engineering discipline, utility of the system often concerns itself, simultaneously, with more than one specific discipline. Therefore, the modes in which D&I of an engineering nature is classified becomes a critical item of concern. The important concept here is that categorizing the contents of a report by a single mode of identification will not be sufficient. It is generally agreed that categorization of data by discipline is a major mode of identification; the ability to search many such categories for the same inquiry is also necessary. To realize a high level of pertinency with respect to information retrieved directly responsive to the inquiry, it will be necessary to classify D&I into a number of other useful categories.

The preliminary analysis revealed seven modes of identification and classification which, in a real system, would probably be considered as seven interacting data banks. These classification mode data banks, which will be discussed in greater detail below, are:

(a) Discipline orientation
(b) Physical item identification and classification
(c) Problem terminology-interdisciplinary
(d) Project terminology- current and completed
(e) Professional registry
(f) Information analysis centers
(g) Locator scheme

2.2.7 Specific system requirements

In addition to the general guidelines above, there is a need for more specific system requirements. Although this report will not delve into a complete exposition of these detailed requirements, the following items represent, as a minimum, the chief requirements that must be considered and carefully examined in the detailed design phase of the DOD/RDT&E STINFO system:

(a) Accuracy: Valid information
(b) Currency: Up-to-date information
(c) Appropriateness: Proper level or degree of technicality or generality
(d) Timeliness: Delivered when needed
(e) Pertinency: Responsive to the request; relevant to the subject
(f) Format: Information provided in the form most useable
(g) Accessibility: Information input and information output from the system should be easy and economical
(h) Understandability: Clear in terms of concept and language employed
(i) Condensed: Succinct with respect to information supplied
(j) Reliability: Portraying a reputation of dependability
(k) Completeness: Proper degree or breadth of coverage

The above listing of system design criteria represents a first-cut identification of the most significant elemental requirements involved in the design, development and implementation of a DOD/RDT&E STINFO service system. A complete list of such requirements would include some of a broader nature as well as many of a more detailed nature. The important factor to be stressed here is that before a firm design can be formulated, a formal investigation and determination of system design guidelines and specific requirements must be developed.

2.3 Overall DOD Mission Orientation

DOD and all of its sub-organizations, military and civilian, are mission-oriented. Every organization within the DOD has been assigned a mission, not only through official charter and other regulations but also as part of DOD's planning and budgeting system, the Five-Year Force Structure and Financial Plan. Manpower and funds are allocated on the basis of the resources required by each organization to accomplish its assigned missions.

With this background in mind, it is logically concluded that the technical information holdings at specific locations are also oriented toward the missions of the respective parent organizations. For example, a technical library servicing a scientific organization concerned with the physical and chemical properties of ocean water would have little need for a sizable collection of documents concerning spacecraft trajectories. Indeed, all of the technical libraries in DOD collectively may not include all the information available on the subjects of oceanography and space technology since some of it is clearly beyond the assigned missions of DOD.

This concept may seem trivial but actually is of utmost importance for it establishes the overall framework within which DOD system concepts must be considered. To be specific, whatever system concepts are designed they will all be within the context of a mission-oriented structure. Although DOD's missions and objectives are broad and encompassing, the disciplines represented within DOD would rarely, if ever, contain a complete storehouse of all technical information available within a scientific and/or technical discipline. It is clear, therefore, that the situation existing in DOD is different from that existing at installations such as the National Library of Medicine, the American Society of Metals, NASA, and AEC. These organizations also have assigned missions; however, their missions essentially require the collection of all scientific and technical information relating to their technical disciplines.

It may be stated that any overall RDT&E STINFO service system within DOD, whatever form it may take, must be responsive to the mission statements of the organizations it serves in order to be useful, in order to be used, and in order to carry out successfully its own mission of providing the maximum contribution to the advancement of science and technology within the RDT&E element of DOD.

2.4 Scope of the DOD/RDT&E STINFO Complex

Before specific approaches to service system concepts are delineated, it is appropriate to describe briefly the scope and extent within which the overall DOD/RDT&E STINFO service system must operate. It is important in any system analysis to comprehend and define the bounds of the system universe; the designer must know whether the limits of the system encompass a stadium, a sandbox or a saucer.

On a national basis, the library community includes approximately 8000 public libraries, 2000 college or university libraries and 73 major research libraries. The current registration for DDC services includes approximately 3000 military organizations, 470 other federal agencies and 2000 industrial and educational concerns. If authorized, most of these organizations have access to most of the 800,000 documents currently in the DDC collection.

To help give a complete overview of the STINFO facilities within DOD, Table D-1, "Summary of Major DOD Scientific and Technical Information Facilities by Geographic Areas," has been prepared. This table gives the major facilities at the Departmental, Army, Navy and Air Force levels. These major facilities amount to 31, 41, 47 and 21 installations, respectively, resulting in 140 major STINFO facilities nationwide. Sixty-eight percent of these facilities are located in the northeast quadrant of the United States.

In describing the 140 major DOD information facilities by geographical area, as discussed above, the word "major" should be strongly emphasized. The actual number of DOD facilities which are holders of scientific and technical information is much larger than 140. For example, the Army's Engineering Data Information System (EDIS) effort has to date identified 257 organizational elements as holders of STINFO within the Army. Of the identified holdings, 71 percent are maintained in the eastern half of the United States, and of these 27 percent are maintained in the Washington, D. C., area. In addition, 36 of the holdings are located at White Sands Proving Grounds, New Mexico. For these reasons, the 257 holders of STINFO within the Army can be considered as 40 to 45 major, but separate, facilities.

Of the 31 major installations at the Department level, 28 are information analysis centers (IAC). These 28 centers are located in 12 cities within 7 geographical areas as shown in Table D-2, "DOD Information Analysis Centers." These are the highly specialized informa-

Table D-1

SUMMARY OF MAJOR DOD SCIENTIFIC AND TECHNICAL INFORMATION FACILITIES BY GEOGRAPHIC AREAS

	GENERAL AREA	DOD	ARMY	NAVY	AIR FORCE	TOTAL
1.	Washington, D. C. Maryland Virginia	11	11	16	2	40
2.	New York New Jersey Pennsylvania	3	6	10	2	21
3.	Illinois/Indiana (Chicago)	3	1	1	0	5
4.	Michigan (Detroit)	4	3	0	0	7
5.	New England (Boston)	3	4	3	1	11
6.	Ohio (Columbus)	5	1	0	5	11
7.	California (Los Angeles)	2	0	10	2	14
8.	Arizona/Utah New Mexico	0	4	0	3	7
9.	Texas	0	4	1	2	7
10.	Alabama	0	3	0	0	3
11.	Florida	0	0	3	2	5
12.	Miscellaneous	0	4	3	2	9
	TOTAL	31	41	47	21	140

Table D-2

DOD INFORMATION ANALYSIS CENTERS
28 Centers in 12 Cities within 7 Geographical Areas

LOCATION	SPECIALIZATION	ORGANIZATION
Washington, D. C.	Chemical Propellants Counterinsurgency Coastal Engineering Deterioration Prevention Engineering Design Entomology (Defense) Oceanographic Shock and Vibration	APL-Johns Hopkins American University Army NAS AMC Walter Reed AMC Natior [illegible] enter NRL
Ohio	Ceramics & Graphite Defender Information Metals (Defense) Radiation Effects Remote Area Conflict	Wright Patterson AFB Battelle - Columbus Battelle - Columbus Battelle - Columbus Battelle - Columbus
Michigan	Ballistic Missile Radiation Infrared Mechanical Properties Seismic	U. of Michigan - Ann Arbor U. of Michigan - Ann Arbor Belfour - Suttons Bay U. of Michigan -Ann Arbor
Massachusetts	Fungus Cultures Human Engineering Nondestructive Testing	Natick Lab - Natick Tufts - Medford Watertown Arsenal
Illinois/Indiana	Binary Alloys Hibernation Thermophysical	IIT -Chicago ONR - Chicago Purdue - Lafayette
California	Atomic Support Electrical & Electronic	GE - Santa Barbara Hughes - Culver City
New York/ New Jersey	Plastics Electron Devices Electronics (SETA)	Picatinny - Dover NYU - NYC NYU - NYC

tion service centers involving subject area experts and physical documents specific to the subject area. The existence and utilization of the IAC's play a definite part in future system designs.

As indicated above, a major portion of the information needed and used by DOD scientists and engineers falls into the category of engineering data. The accession, indexing, storage and retrieval of such information comprise a most important part in any DOD/RDT&E STINFO service system concept. It is clearly beyond the scope of this report to study the intricacies involved in processing engineering-type information. However, to portray the scope of engineering information activities currently engaged in by the federal government, Table D-3, "Federal Information Activities Concerned with Parts, Applications, Reliability and Materials Engineering", has been prepared.

There are several aspects of this table that should be emphasized. To begin with, much of the effort involved is applicable Government-wide, such as Federal Stock Numbers, identification guides, and various Federal service and supply centers. For this reason, any system that addresses itself to controlling and organizing engineering-type data would, for the sake of efficiency, have to consider the interdepartmental problems throughout the Government. Therefore, departments other than DOD are shown in the table.

Secondly, the 28 IAC s are included within the elements of the table. This, of course, implies that these centers not only are concerned with information contained in project reports but are also involved with other data such as drawings, parts lists, specifications, standards, test reports and reliability studies. The reasons for this concern by the IAC s are logically obvious.

2.5 Integrated Network Approach

Information is the most important input to the decision-maker. Characteristically, the situations in which decisions must be made are becoming more complex, and the need for information is correspondingly increasing. Science and technology and the Government are encompassing more and more interrelationships, and the need has become ever greater to provide the decision-maker with more information. The DOD/RDT&E information problem has been defined as a "multiplicity of interacting complexities." A careful analysis of these factors invariably leads to the conclusion that in order to solve the myriad of technical problems, an integrated network approach ap-

Table D-3

FEDERAL INFORMATION ACTIVITIES
CONCERNED WITH PARTS, APPLICATIONS,
RELIABILITY AND MATERIALS ENGINEERING

FEDERAL GOVERNMENT

DOD - Department of Defense

DEFENSE SUPPLY AGENCY

DDC-Defense Documentation Center (TAB)
MILSTICCS-Military Std. Items Char. Coding Structure
EDRS-Engineering Data Retrieval System
LIIDS-Logistics Item Identification Data Sheets
Item Entry Control Program-Updating (DSA + 3 SVCS)
Federal Catalog Improvement Program (Fed. Stock Nos.)
FIIG & LIIG-Federal Logistics Item Identif. Guides
DLSC-Def. Logistics Service Center (Battle Creek)
DESC-Def. Electronics Supply Center (Dayton)

ARMY

ADRES-Army Data Retrieval Engineering System
EDS-Engineering Data Systems
PLASTEC-Plastics Technical Evaluation Center
USAEMA-U.S. Army Electronics Material Agency
DARE-Documentation Access Retrieval of Eng. Data
IDEP-Interservice Data Exchange Program
STINFO-Scientific & Technical Information
EDIS-Engineering Data & Information System
IDEEA-Info. Data Exchange Experimental Activ.
TIAC-Technical Information Analysis Centers
CIDS-Chemical Information & Data System
ATLIS-Army Technical Library Improvement Studies
TEL/TIPS-Tech. Effort Locator/Tech. Int. Profile
Data Files-Res. Resumes (1498) & Doc. Data (1473)

Table D-3 (cont'd)

IDC

FEDERAL INFORMATION ACTIVITIES
CONCERNED WITH PARTS, APPLICATIONS,
RELIABILITY AND MATERIALS ENGINEERING

NAVY

- NSD-Naval Supply Deport
- NATSF-Naval Air Technical Service Facility
- IDEP-Interservice Data Exchange Program
- FARADA-Failure Rate Data
- LPIA-Liquid Propellant Information Agency
- SPIA-Solid Propellant Information Agency
- STINFO-Scientific & Technical Information
  - NARDIS-Naval R&D Information System
  - IAC-Information Analysis Centers

AIR FORCE

- MEDAL-Micro-min. Engr. Data for Automated Logistics
- IDEP-Interservice Data Exchange Program
- RADC/RC-Rome Air Dev. Center-Reliability Control
- AFELIS-AF Engr. and Logistics Information System
- EDMS-Engineering Data Micro-Repro. System
- TIC-Transducer Information Center (Battelle)
- STINFO-Scientific & Technical Information
  - AFML-AF Materials Lab
  - IAC-Information Analysis Centers

NASA-National Aeronautics & Space Administration

- OSTI-Office of Scientific & Tech. Inf. (STAR)
- PRINCE-Parts Reliability Information Center
- PASS-Parts Analysis Summary Sheets
- Other Parts Data Centers: New, Semicond. & Use Data

Table D-3 (cont'd)

FEDERAL INFORMATION ACTIVITIES
CONCERNED WITH PARTS, APPLICATIONS,
RELIABILITY AND MATERIALS ENGINEERING

AEC-DTIE-Division of Technical Information Extension
DASA-TREES-Transient Rad. Eff. (on Elect. Syst.)
CFSTI-Clearinghouse For Scientific & Tech. Inf.
Library of Congress-NRC-Nat'l Referral Ctr. for Science & Tech.
NBS-(Nat'l Bureau of Stds) -EDDS-Electronic Devices Data Svc.
AGED-Advisory Group on Electronic Devices
SETE-Secretariat of Electronic Test Equipment

pears to be the most feasible concept and the most powerful tool available to cope with such a problem.

The concept of a totally centralized, massive information installation which receives, holds and distributes all RDT&E information generated and required by system participants (at one time considered the most logical solution) is probably technically undesirable and an unworkable approach from the standpoints of economy, effective organization and overall feasibility.

In most systems design efforts, the overall approach selected has a very significant effect on the technical integrity and success of the designed system. Selection of the integrated network approach, as opposed to the massive central store, is a major decision with far-reaching effects. It must be pointed out, however, that the integrated network approach addresses itself to maximum effectiveness of the communication links and does not concern itself with problems of a political, organizational, geographic or discipline nature. Some of these problems will be discussed separately below.

2.6 Information Transfer Centers

Every communication network is composed of nodes (or terminals) as well as lines of communication between the nodes. This discussion involves the characteristics of these nodes. Questions must be resolved such as: What is the function of the nodes, where are they located, what do they contain in the way of information, who do they communicate with, how are they organized, how do they operate and when must they be established? All of these questions will not be answered herein; however, the significant elements will be discussed.

A node will be defined as an Information Transfer Center (ITC). The concept of an ITC is closer to the envisioned functions than are other common terms which carry different connotations such as "switching center" or "referral center". Depending on the system approach employed, the ITC performs a number of important functions. Descriptions of the individual system concepts will delineate the various responsibilities of the ITC's. However, some of the more important functions which might be performed at these ITC's are as follows:

(a) The local ITC is the area communication link with, and means of access into, the total system. The ITC, therefore, is the direct communicator with the system user (information requester).

(b) Each ITC specializes in a specific discipline and has in its employ experts in the subject area of that discipline.

(c) Each ITC has available a complete location index of all holdings in the system. Although it is logical that the knowledge of document location does not imply knowledge of document content, the successful operation of the network will depend heavily on ready access to the full capacity of the system by each ITC. The internal capability to locate the information requested among the total complex of ITCs within the network is possible through this detailed index of holdings located at every ITC.

(d) Each ITC can be physically located so as to optimize its organizational coverage as well as its accessibility to the organizations and individuals it serves.

(e) Each ITC can be organized by areas in such a way as to maximize its geographical coverage. This would also improve access into the system.

(f) Each ITC can be organized by disciplinary functions so as to make it possible for geographical areas specializing in a specific discipline to be served by an ITC specializing in that discipline.

(g) Each ITC could be a storehouse of hard-copy, or have sufficient blow-back capability from microforms, in order to provide data of immediate interest to the local user.

The operation of an ITC and the total interconnecting network of ITCs may be considered a "system of systems". Each ITC functions as a system within itself having specific capabilities and service requirements which it performs for its assigned area. It is an operating service system and, at the same time, a part of a national network of interconnected service systems. It is not envisioned that each

ITC is in direct communication with every other ITC as such an approach would result in an inefficient maze of cross-communication lines. Instead, a Regional Transfer Center (RTC) which would perform a switching function would probably be employed. The RTC would be the collection point for all of the ITCs within the region and would communicate with other RTCs which would transfer the information to the appropriate ITCs. The RTC may serve as a centralized facility for the preparation of micrographic masters near the source of origin, resulting in standardized high level reproduction. In lieu of having hard-copy, or production blow-back capabilities from microform, located at each ITC, it may be more efficient to centralize such services at RTCs. The RTC might also perform an additional function of serving, itself, as an ITC.

Through utilization of ITCs as part of an integrated network approach, the effectiveness of the communication links between system elements will be maximized and the operational system will have the greatest efficiency as well as the highest probability of successful operation.

2.7 Conceptual Network Approaches

Having established the justification for a decentralized network approach employing ITCs, as opposed to a massive central store, and having delineated some of the more significant system design requirements pertinent to the DOD/RDT&E STINFO problem, it now becomes possible to suggest some conceptualized network approaches toward solution of these problems. It must, again, be pointed out that the approaches suggested below do not represent a firm conviction that these are all or even the best of the possible approaches significant to solving the complex DOD/RDT&E STINFO problem. These approaches represent, as a first-cut, those which appear worthy of consideration toward solution of the problem.

2.7.1 Concept A: Organizational Approach

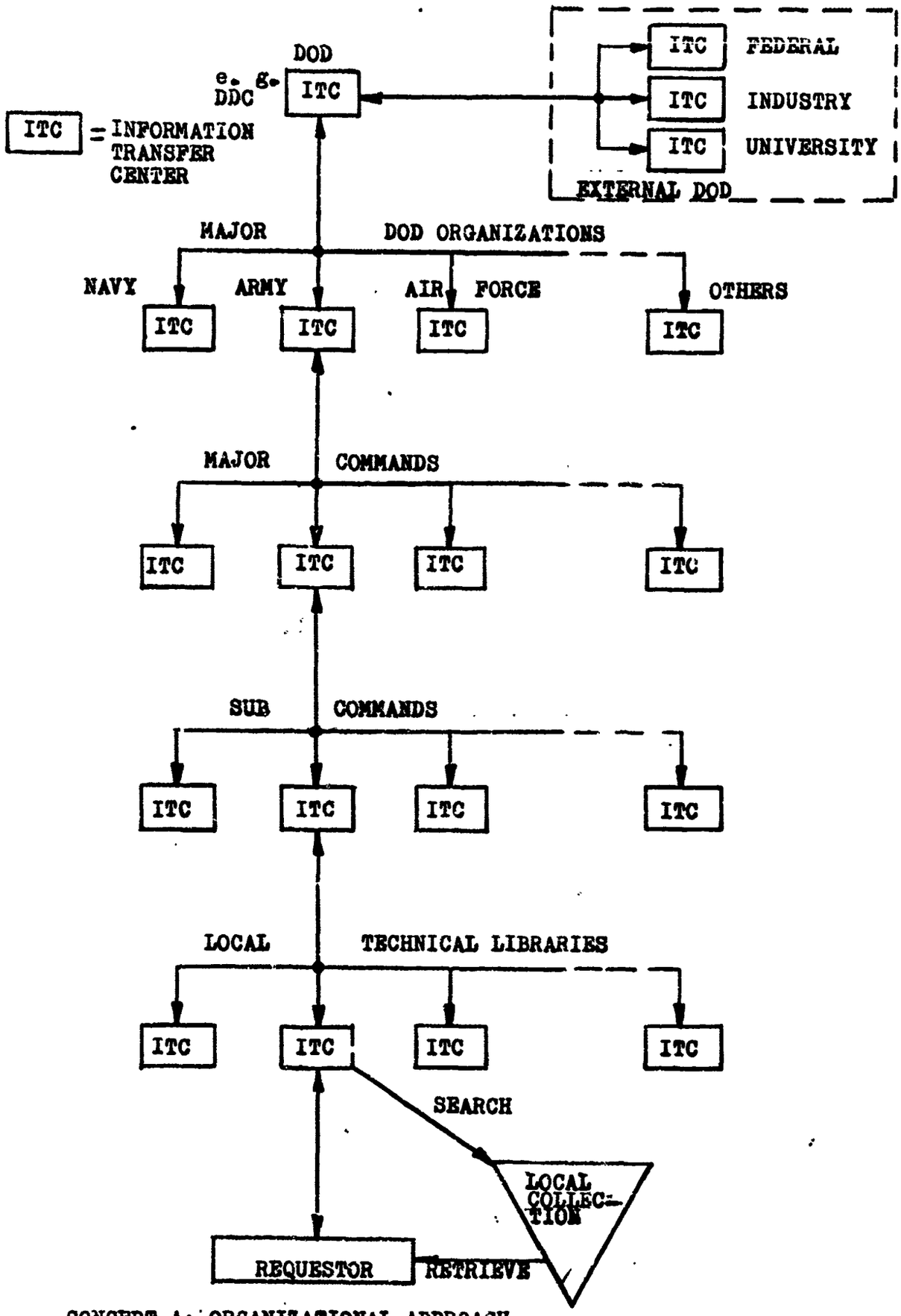
The rationale for considering an organizational approach to the solution of the DOD/RDT&E STINFO information problem is quite obvious; a well-structured organization exists. Furthermore, even though an organizational approach may obviously be deemed not the optimum solution, in order to comply with the evolutionary system implementation discussed previously, starting with the existing organizational setup affords additional inherent advantages. Official lines of communication and management control are effectively organized. It is,

therefore, logical to assume that the existing organizational structure is a good base from which to build subsequent, more elaborate and more effective system concepts.

A further justification for using the existing organizational structure for a starting point involves the established STINFO program within DOD. The STINFO program is a basic and integral part of the RDT&E function of DOD. Each operating activity that performs an RDT&E function has an established "STINFO office" and a designated "STINFO officer." Furthermore, each RDT&E activity has the responsibility for promoting the transfer of scientific and technical information that results from its own efforts. The STINFO program has been well underway for over three years and forms the nucleus of an existing organizational approach toward initial solution (if only a partial solution) to the overall DOD/RDT&E STINFO problems.

An overall flow chart depicting the information links involved in Concept A is shown as Figure D-1, "Concept A: Organizational Approach." Figure D-1 is read from the bottom up, starting with the requester, who contacts his local technical library with a query. This query may take several forms; however, it is basically a request for information--in particular, bibliographic information. The local technical library serves as an ITC and performs two functions. First, it searches the local collection in an attempt to provide immediate response to the inquiry. The requested information (and/or hard-copy, microfiche, etc.) is retrieved and dispatched to the requester. If the local collection of data and information is properly stocked and adequately organized to satisfy the needs of the local community, it should be able to respond to the inquiry in an immediate and satisfactory manner in a large number of cases. Second, if the request cannot be satisfied locally, the local technical library serving as the ITC then relays the request to the next higher echelon.

The appropriate sub-command receives the request and, serving as another ITC, then performs two functions. The first function is to transfer or channel the request to other local technical libraries which might possibly respond to such an inquiry. This last point is fundamental. The ITC at the sub-command level would not necessarily communicate with all local technical libraries within its purview. Instead, it would have at its disposal a location function which would indicate the areas of interest covered by its subsidiary ITCs.



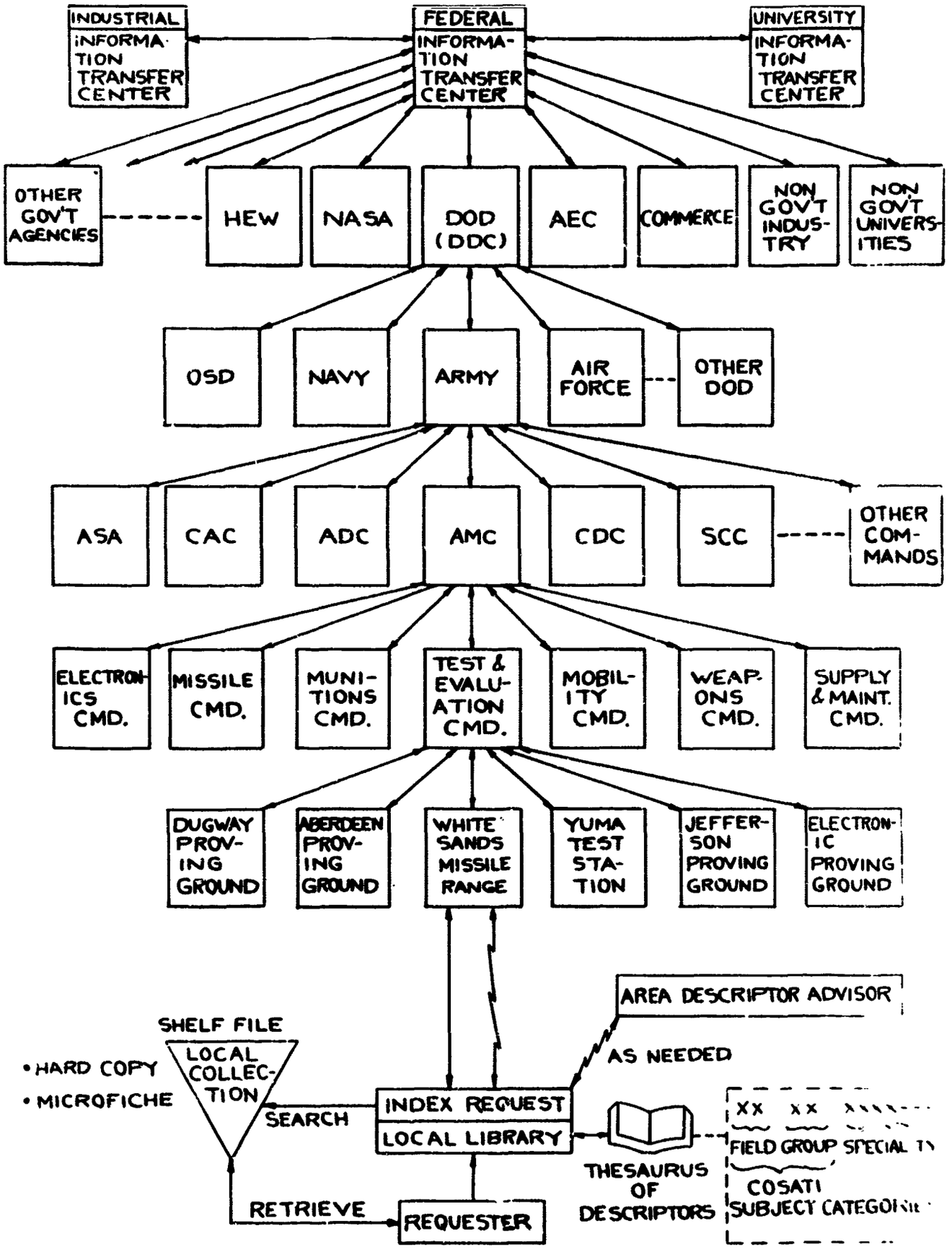
CONCEPT A: ORGANIZATIONAL APPROACH
TIME FRAME: 1966-1967 (including overall coordination)

Figure D-1

The second function of the ITC at the sub-command level is to transfer a request to the next higher echelon. The major command level receives the inquiry and processes it in the same manner as described for the sub-command, i.e., the other appropriate sub-commands are interrogated and the inquiry is transmitted to the next higher command, namely, the departmental level. In the example, the Army would then interrogate its major subsidiary commands where the area of activity matches the subject matter of the inquiry, and then transmit the request to the ITC serving the DOD. This DOD/ITC could conceivably be a function performed by DDC. The DOD/ITC performs the same functions as the other ITC's described above. In addition to transferring the request to the other major DOD organizations, the DOD/ITC would communicate with ITC's in the other three major communities, namely, Federal (other Government agencies), industrial (non-Government) organizations, and the university complex.

Conceptually, it is important to visualize the ITC's as operating just as efficiently whether mechanized or non-mechanized. In fact, it is apparent from the standpoint of cost alone, that all of the ITC's in the DOD would not be computer functions. At the departmental and major command levels the ITC function might, in part, conceivably be a computer function. However, if this concept is advantageous primarily from a standpoint of a place to start--a base -- in the long-term evolutionary development of a more elaborate and more effective system, it may be undesirable to mechanize any but the highest elemental centers where, because of sheer volume of the data, a computer application would be justifiable. Indeed, the non-mechanized aspects of the organizational approach have distinct advantages.

A specific example is shown in Figure D-2, "Concept A: Organizational Approach - Army Example". The figure shows how the organizational approach provides access to the total store of RDT&E STINFO within DOD by an individual requester at the lowest organizational element. The example in Figure D-2 shows a requester submitting a bibliographic inquiry to his local library at one of the outlying information facilities at White Sands Missile Range. It is important at this early stage to put the request into proper terminology. This, of course, is done by the combined efforts of the requester and the librarian through use of a thesaurus of descriptors. The thesaurus at this level must be segmented into a finer element of specificity than implied by the four-digit COSATI subject category breakdown into fields and groups within fields. It must go at least one step further into a specialty since the requester, being a specialist, will invariably make



DOD BIBLIOGRAPHIC REQUEST PROCESS 1970/71
CONCEPT A: ORGANIZATIONAL APPROACH

Figure D-2

his request in terms far more specific than those appearing in the field and group categorization.

Another problem concerns the capability of the librarian to adequately index the requests for subsequent retrieval. It can be assumed that most of the requests could be handled by the local librarian; however, if problem areas arise beyond the capability of the librarian, the system envisions the availability of a thesaurus expert called the "area descriptor advisor." This advisor would be located in regional areas and available through the telephone (or other communication modes) on an as-needed basis.

Before the request is transmitted to higher organizational elements, the local library would search its local collection (hardcopy and microfiche) in order to determine if the request could be satisfied locally. If the local library is adequately stocked with data pertinent to the demands of its users, the immediate search of the local collection should retrieve much of the information required. The request in the example cited is for bibliographic data so, despite the results of local retrieval, the request must be transmitted to higher echelons.

The request is submitted or transmitted to a central ITC located at White Sands Missile Range. The local communication problem to the central ITC may in some cases be no problem whatsoever and in other cases represent an involved communications problem. It is also implied here that either the local library or the library at the central ITC is in direct communication with all of the other libraries at White Sands, so that internal flow of documents and information between organizational elements within and among the complex is handled entirely on a local basis in whatever fashion is most suitable to the circumstances.

The information inquiry is then transmitted to the Test and Evaluation Command as shown in the example. At this point the information inquiry is transmitted to other elements within the command where it has been determined that the subject matter matches the information requested. As described earlier the information travels up the "tree" as a request and down the "tree" as a response. The downward travel is more conceptual than real since documents could be dispatched directly to the requester's local library. Because response to the request travels along organizational lines, it has a built-in capability for assuring authorized dissemination of information.

The current lines of communication and management control, along with the responsibility and authority to accomplish certain missions, provide an ideal vehicle through which the overall objective of the information system may be attained. One of the problems involved in successfully attaining the goals of an overall DOD and RDT&E STINFO service system is how to get people to comply with the regulations set up to foster such attainment. DOD, being the large, decentralized organization that it is, characteristically responds quite slowly to all but the highest priority requirements. This being the case, it would be exceedingly difficult to get "the machinery rolling" in whatever system is conceptualized and implemented. The built-in management and authority control is an ideal vehicle for bringing about a unified, cooperative, deliberate and effective communication system. Such an approach may have a far better chance of success than a system concept requiring broad changes in organization, far-reaching legislative actions, or equivalent development requirements beyond the state-of-the-art.

2.7.2 Concept B: Geographical Approach

The rationale for considering a geographical approach to the solution of the DOD/RDT&E STINFO information problem is evident; a structured and organized dispersion of RDT&E personnel and materiel currently exists. Some of the arguments in favor of the organizational approach (Concept A described above) are also applicable to the geographical approach to solution of the information problem. Namely, it is easier to build upon an existing structured and organized framework than to implement an entirely new system framework.

The outstanding feature of a purely geographical approach can be expressed in one word: convenience. The entire concept is based upon the single goal of making access to and output from the system as convenient as possible to the user. Placing special emphasis on this aspect of the problem solution is very important from the standpoint of system utilization; the easier it is to use the system, the more it will be used. Stated in another way, the more personalized the service is, the greater is the probability that the user will be adequately served by and content with the information system.

There are, however, some underlying difficulties with a purely geographical approach to solution of this very complex problem. One argument is that the geographical approach would be strongly influenced by the organizational setup; in fact, the two may not be separable as such because in many instances the geographical structure has been

designed to align itself with a pre-established organizational structure (or vice versa). If this is the case, the logical conclusion is that there could be no such thing as a purely geographical system. In addition, establishment of a system purely on the basis of geographical dispersion, with no regard for organizational setup and with no consideration for official lines of authority, would certainly make it difficult to implement as well as operate such a system.

The most serious objection to a system conceived and designed on the basis of geographical distribution alone is the problem of duplication. ITC's established on a geographical basis would require duplicate facilities and would necessitate replicate queries to all other centers for answers to questions. It should be noted here that the problems that would evolve as a result of a design based on geography alone would, in many respects, resemble the current state of affairs where everyone is talking to everyone else and information is flowing between any and all elements of the RDT&E STINFO community within and without DOD.

The geographical location of the users, the geographical location of the information they require, and the geographical location of the material they request are all very significant elements in the design concept. However, it appears that a system designed on the basis of geography alone would not appreciably solve the existing dilemma.

2.7.3 Concept C: Discipline Approach

The COSATI Subject Category List, dated December 1965, provides, for the entire Government, an overall basis for the subject grouping of reports for announcement and distribution purposes. The document categorizes all scientific and technical information into 22 broad subject fields and further subdivides these fields into 188 groups. The information content of every document, covered by the RDT&E STINFO purview, is subject-categorized through the use of these terms. In addition, the analysis of any query must include identification of the disciplines involved. In other words, both the request and the filing system utilize the same language. The rationale for considering a disciplinary approach to the solution of the DOD/RDT&E STINFO information problem is clear. A conceptualized network on the basis of discipline, alone, has merit in that the categorization, the filing and the retrieval all utilize the same language, thus providing practicality, efficiency and effectiveness in the retrieval mechanism. It is significant to note, once again, that the discussion under paragraph 2.4 concerns itself with information storage and retrieval with respect to the content

and location of documents; it does not involve the physical document storage and retrieval process itself. The latter function will be discussed in paragraph 2.9 below.

The COSATI field and group breakdown provides complete coverage of all scientific and engineering disciplines. However, practical utility by the individual scientist or engineer dictates the requirement to further categorize the groups into sub-elements which are referred to as "specialties." In almost every case, the user of the system will ask for documents and ask for information about documents on the basis of the specialty within the group within the overall scientific and technical field.

Implementing an information system purely on the basis of a disciplinary categorization of information has its own inherent disadvantages. One obvious disadvantage of this approach is the fact that, when a document concerns itself with more than one discipline (as many of them do), the information regarding that document must be duplicated in each of the discipline-oriented areas that are involved. Although this statement is true, it is believed that the resulting duplication of citational information would not be excessive and would be, in fact, a tolerable consequence that the system could bear, assuming everything else worked properly.

2.7.4 Area/discipline overlay approach

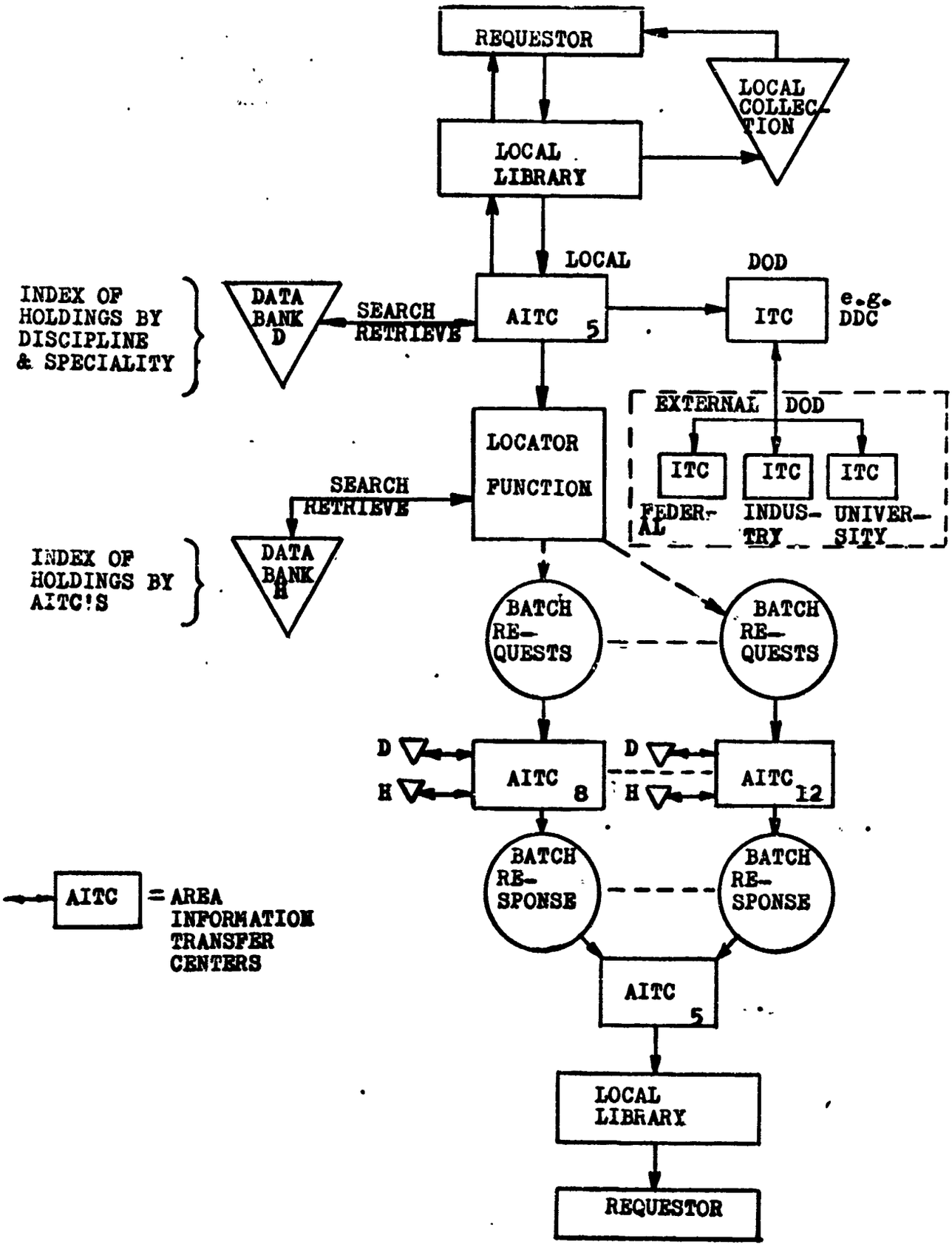
The advantages and disadvantages of the geographical and discipline approaches have been discussed above. Although there were considerable advantages given for structuring a system purely on the basis of either of these approaches, it is clear that an optimum structure would not result from either approach. It becomes logical to consider, at this point, whether the advantages of these two approaches could be combined so that together they collectively overshadow the individual disadvantages. The concept then involves a very intricate overlay procedure in which the advantages of both approaches are maximized. The resulting area/discipline approach is, therefore, a composite concept minimizing the disadvantages described above.

The overlay procedure is, quite obviously, a difficult and intricate task. The basic guidelines are to place the ITCs concerned with specific disciplines as close as possible to the high-frequency users of this data bank. At the same time, the ITCs are structured geographically in such a way as to maximize the area encompassed and minimize the communication links between the nodes.

Figure D-3 "Concept D: Area/Discipline Overlay System" describes the overall operation of the concept. The figure is read from the top down and starts with a requester, who interrogates his local library in a manner identical to that described for Concept A above. His request for information (bibliographic or otherwise) is relayed to the area information transfer center shown as AITC 5 in the example. The data bank of interest is physically at this ATIC, if its discipline specialty has been properly located. AITC 5 has a very complete and detailed index of all of its holdings within its discipline specialty. This data bank is searched for the material requested, and, if retrieved, the information is transmitted back to the requester. The local ITC has a second data bank with a generalized index containing all holdings of every other ITC. If the inquiry cannot be satisfied (entirely or in part) locally, it is then batched with other inquiries according to the locations of the information requested. At specific intervals, the local ITC dispatches the request batches to the appropriate ITC's. The batch process implies that there is no real-time on-line communication at all times between the ITC's. When the request is received by the appropriate AITC's, their detailed data banks are searched and the required information is retrieved. This information is also batched in anticipation of transmission back to the original requester through his local ITC.

In addition to the interaction between AITC's, the local AITC communicates with the DOD ITC (a function which DDC could well perform). The DOD ITC dispatches the request to areas external to DOD where it is determined that a response might exist. As shown on the figure, the DOD ITC communicates with three ITC's representing the three communities: Federal (other Government), industry, and university complex. The concept basically implies that communication between the ITC's is via a telecommunications media. Although it appears unfeasible to transmit full-text material by this media, bibliographic and other brief information responses could easily travel over this rapid means of communication. If the system is to provide more than merely a list of references, other media such as facsimile or long-distance xerography or even the U. S. mail may be employed.

In addition to supplying bibliographic material to the requester, the system could provide him with another useful product in the form of a prepunched deck of tabulating cards which he could use to request the material selected after a review of the bibliographic listing. These cards, when submitted to the system, would automatically trigger the retrieval mechanism.



CONCEPT D: AREA/DISCIPLINE OVERLAY SYSTEM
TIME FRAME: 1970-1971

Figure D-3

The overall advantage of the area/discipline approach is that it seems to be a basic step toward solution to the overall DOD/RDT&E STINFO problem. However, the obvious disadvantage is that it will not be possible in every case to maximize the location of the ITCs. Although it would be possible in many cases to place a disciplinary-oriented ITC in an area where the frequency of use of this discipline is the greatest, it would not be possible to do so in all cases. This does not detract from the obvious advantages of the approach. Indeed, if the ITCs are all part of an integrated network system where each node has established effective communication links, the cases where the proximity of the data bank of interest cannot be achieved will be more than compensated by the efficiency of the communication system.

2.7.5 Other modes of data identification

One of the fundamental requirements for which a successful information system has to provide is the capability to store and retrieve data in the language used by RDT&E specialists. In order to bring about a high level of pertinency with respect to information retrieved directly responsive to the inquiry, it will be necessary to classify D&I into a number of useful categories. The preliminary analysis revealed seven modes of identification and classification which, in a real system, would probably be considered as seven interacting data banks. These various modes of identification and a brief description of each are as follows:

(a) DISCIPLINE - A unique subject orientation.

(b) PHYSICAL ITEM - Identification and classification of data other than documents such as drawings, specifications, and standards. Interdisciplinary items which may or may not be subject oriented.

(c) PROBLEMS - Interdisciplinary terminology of the problem statements. Functions as a logical analysis and synthesis of unstructured inquiry statements to convert such statements to searchable language terms.

(d) PROJECTS - Current research in progress as well as completed projects. Indexed by project-type terminology.

(e) PROFESSIONAL REGISTRY - A knowledge pool or cross-listing of individual scientific and technical experts within DOD.

(f) LOCATOR - Coding scheme by which requests are analyzed and channeled to appropriate data banks.

(g) INFORMATION ANALYSIS CENTERS - Highly specialized banks of information, and technical experts in the field. Function as subsets of the discipline-oriented data banks.

It is likely that other categories of information identification and classification not only exist but would be a firm requirement if the system is to function as a dynamic and responsive information service .

2.8 Conceptual Distribution Subsystems

2.8.1 Introduction

The discussion in Paragraph 2.7 above related to the transmission of information throughout the conceptualized networks. This section, on the other hand, addresses the problem of document production, storage and distribution. The analysis has approached the overall problem in accordance with the "dichotomy" guideline stated previously in Paragraph 2.2.2, namely, that the overall problem should be broken up into two separate elements - information management and document management. This section deals with the latter. However, it will not concern itself with detailed internal DDC document handling, storage and distribution problems. The subsystems described below pertain to overall DOD/RDT&E STINFO service concepts.

2.8.2 Centralized distribution

Whether document distribution should be centralized or decentralized is a controversial matter; both approaches have their advantages and disadvantages. This section presents the case in favor of centralized distribution. Currently, DOD agencies decentralize responsibility for primary distribution and centralize secondary distribution at DDC. However, secondary distribution is not performed entirely by DDC

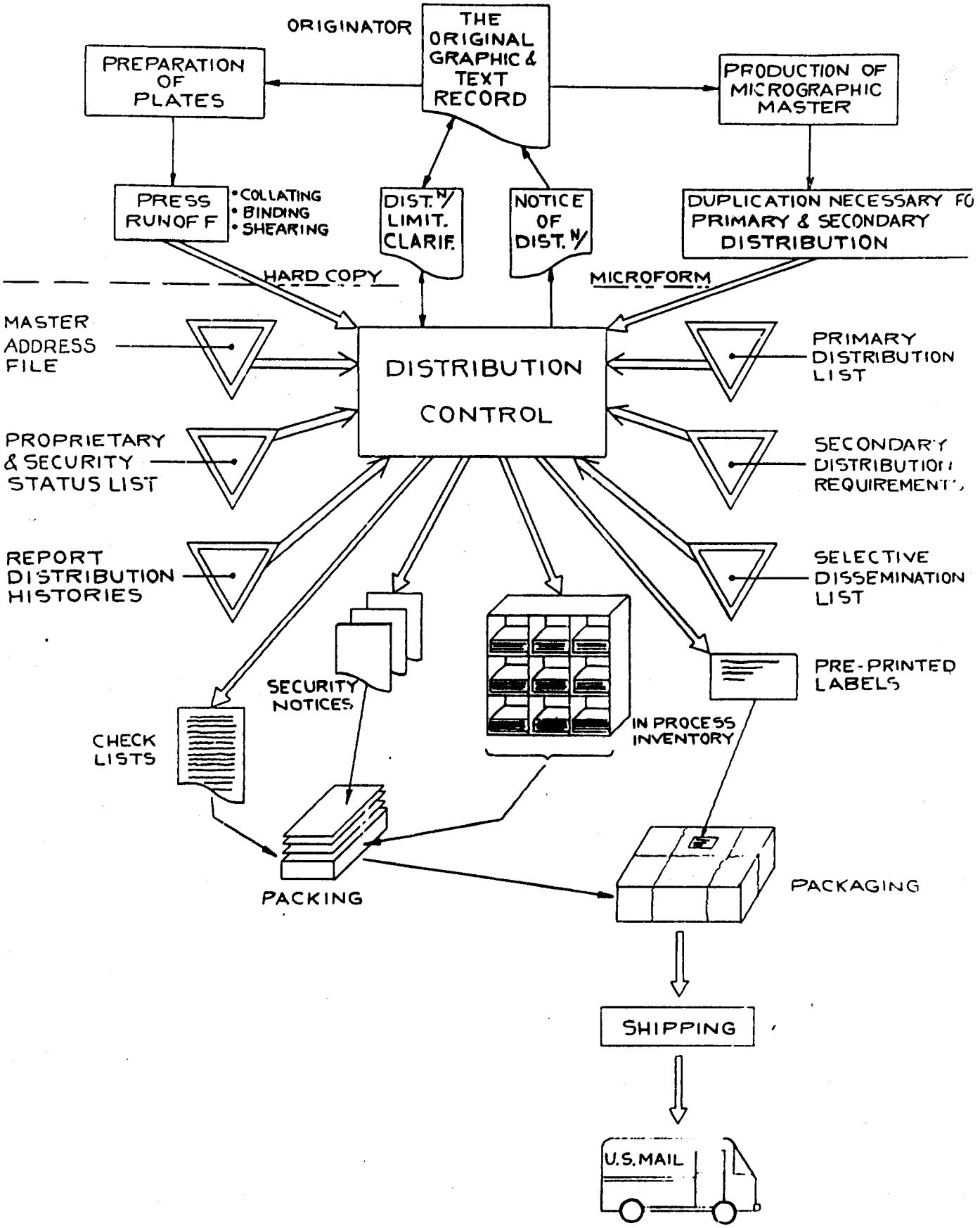
since many sources prefer to maintain secondary as well as primary control of their documents. DDC currently receives approximately 50,000 of the estimated 70,000 scientific technical documents produced in DOD each year.

A number of serious problems arise as a result of the decentralization of responsibility for publication and primary distribution. For example, distribution lists are frequently incomplete, incorrect, or obsolete. These lists tend to retain names of users no longer interested in the material being sent to them. Up-to-date mailing address lists present maintenance problems because interested recipients frequently change location. The burden falls to decentralized RDT&E activities to seek out, on their own initiative, new potential users. The alternative is to rely solely on secondary distribution services to reach the interested users outside the immediate group known to the originators. The bulk of these administrative efforts and maintenance activities is duplicated at every RDT&E activity engaging in the publication and primary distribution of their own scientific and technical reports.

Many of the distribution problems stated above could be solved if all distribution took place from a central point. Such a concept would integrate the functions, and, as a result, overall system optimization would become possible through greater overall system control and responsiveness. Figure D-4 "Centralized Distribution System," displays the generic features of a plan for centralized distribution of technical documents. The preparation of printing plates from the original graphic and text records and the subsequent press runoff would continue to be a responsibility of the originating organizations. Production of the micrographic master should take place at or near the source. If this is unfeasible, controls should be exercised to ensure the high quality of the hard copy dispatched to DDC for microphotography. In either case the micrographic master would be duplicated in sufficient number to handle both primary and secondary distribution. The hard copy and microforms would be stored as in-process inventory in a distribution control center.

This distribution control center would have at its disposal six separate data banks providing the control mechanism for operation of the centralized distribution function. The six data banks are as follows:

(a) Master Address File - This data bank contains a continuously updated master



CENTRALIZED DISTRIBUTION SYSTEM

Figure D-4

file of addresses of all authorized recipients for classified or limited RDT&E reports. Maintaining the currency and accuracy of this file would be a major concern of the center.

(b) Proprietary and Security Status List - This data bank, in effect, is a highly formalized, organized and effective extension of the current mechanized file of registered users. The effectiveness and ease of operation of this registry of authorized users can be significantly improved in the context of an official, organized, centralized distribution system. With proper effort, and appropriate controls by the users, this data bank can be an effective tool for assuring compliance with security, proprietary and distribution requirements.

(c) Report Distribution Histories - This data bank is principally a statistic-gathering file containing significant elements needed to control effectively the entire physical distribution handling system on a centralized basis. In particular, the statistics would involve the "frequency of use" histories providing important inputs to hard-copy stock reduction programs and published high-demand bibliographic products. The statistics gathered from this data bank would interface with all functions involved in document management.

(d) Primary Distribution List - This is a key list which would be supplied to the distribution control center from all user organizations or cognizant military monitoring agencies. The lists of authorized primary recipients in this data bank would be superceded by any proprietary or security limitations. This file would be dynamic

in the sense that it would be continuously monitored to ensure validity and currency.

(e) Secondary Distribution Requirements - This file is the most active of the six files in the sense that it is constantly receiving requests for documents. Depending on the announcement mechanism employed, these requests might come prior to publication as well as subsequent to publication. Prior-to-publication requests, received as a result of research-in-progress announcements, are forwarded to the originator before publication so that the initial press runoff might include as much as possible of what normally would have been secondary distribution document requirements.

(f) Selective Dissemination Lists - This is the file from which initiative action is taken to disseminate information of immediate value to registered users. The input information for this data bank may come from the 1498 resumes, demand bibliographies, and state-of-the-art requirements, as well as other sources establishing the criteria for distribution of current awareness information.

The central distribution control mechanism would, through mechanical means, automatically produce several other by-products necessary for the distribution of in-process inventory; for example:

(a) Pre-printed mailing labels.

(b) The proper number and format of security notices required in the packing and packaging operations.

As the result of recent rapidly moving advancements in automated typographic composition technology, it is now technically feasible to reduce duplication of effort substantially; eliminate obsolescence and incorrect distribution; and gain earlier, more extensive and more precise knowledge of "who wants what" for primary distribution. The integrated publications service system concept described below need not encroach upon the sound policy and continuing responsibility for the originating RDT&E activity to withhold publication until it is ready to release it, to specify distribution (both permissive and restrictive) and, in short, to retain all decision-making responsibilities as now exercised.

An additional benefit from the publication production method to be described is the no additional cost capture of full report text in machine-readable form. As computer-based automatic processing methods for content analysis are perfected, an increasing need will exist for full-text machine-readable records. In DOD publication controls are being enforced on styling and formatting of publications. Items of interest to DDC, such as titles, authors, originating agency, report number, descriptive catalog entries and author abstracts, can be recognized automatically without the need for extensive manual intervention. It is technically feasible to process these automatically after screening and admittance to the system.

2.8.3.1 Description of system operation

At source locations, punched paper tape (or even tab cards) can be produced on equipment not unlike the typewriters presently used for cold composition. The keying operation results in a platen proof, and obvious typographic errors can be immediately detected. Machine-readable text and supporting data can then be forwarded (by mail or leased wire) to production centers where typographic-composition computer programs assemble the first proof copy of the technical report. Difficult mathematical equations and other displays not amenable to offline keyboard composition are forwarded for manual insertion at the central publication service. This in no way detracts from the substantial benefits of the centralized publication service.

A number of output products are produced using computer facilities and programs for production routines. These output products and by-products include:

(a) Photocomposition magnetic tapes that feed automated photocomposition equipment

(b) Proof copy return to source

(c) Production runoff

(d) Distribution/limitation orders

(e) Production control documents (mailing labels, check lists, security notices, etc.)

(f) Management statistics (traffic, acquisition, productivity security cost, etc.)

(g) Information products (abstracts, announcement lists, bibliographies, etc.)

2.8.3.2 Advantages of a centralized publication service

This service concept brings the objectives and responsibilities for primary and secondary report distribution into very close proximity. The approach will achieve more effective distribution of technical reports and more efficient operation of associated production facilities. Specific advantages potentially available include:

(a) Centralized user-interest registration point to improve primary distribution.

(b) Full report text in machine-readable form for further automatic processing at no extra keyboard costs - this is the fountain head for low cost production of related information products and services.

(c) Check lists for use by stockroom clerks in controlling the quantity and identification of shelf items to be shipped.

(d) Automatic notices of distribution to originating agencies keeping them informed of the recipients of documents produced by them.

Following this, the normal packing, packaging, shipping, and mailing operation takes place with a minimum amount of time, cost, and effort expended. The centralized distribution system would essentially eliminate misdirected reports and, as a result of the centralized operation, provide an efficient and effective information service. There is potentially great dollar savings in the centralized maintenance of distribution and mailing address data along with other records associated with distribution. Although the cost accountability is widely dispersed, the cost savings are considerable. At the same time the effectiveness and completeness of the primary distribution function can be greatly enhanced.

2.8.3 Automated publication production

Although it is a relatively stable production process at any point in time, for a variety of reasons DDC must be viewed as a dynamic, evolutionary operation. DDC must parallel, and in fact anticipate, the changing and growing information requirements of the rapidly developing scientific and technical community it serves. Information technology itself will continue to develop and mature and in so doing will create the new ways to provide services and generate information products faster, cheaper, and better.

In view of these factors, DDC should be considered an operation whose products and services must constantly be subjected to close scrutiny for possible ways to serve better the ultimate scientific and technical user. In order to anticipate expanded system requirements, this section describes methods of performing: (1) data conversion to machine-readable form at source, (2) transmittal, (3) automated composition and publication, and (4) combined primary-secondary distribution from a central facility. The latter item was discussed in the preceding section so attention will be directed to the first three items.

(c) Major cost savings through reduction of personnel and facilities at hundreds of diverse publication operations.

(d) Earlier primary distribution through shorter publication production cycle.

(e) Elimination of misdirected reports - dropped interest or changed address.

(f) Lower publication production costs.

(g) Uniform control of reproduction image, quality and graphic arts.

(h) Centralized control of document security status.

(i) Centralized statistical data on publication and information service activity.

As plans for Government-wide systems progress, the concept of machine-readable text under controlled format conditions at no extra cost offers a means for achieving the dual objectives of individual agencies. An agency must retain responsibility for providing output products to meet its users' needs and at the same time employ efficient means and encourage compatible operations among other agencies in order to eliminate or reduce duplicate cost and effort.

2.8.3.3 The integrated systems concept

The automated publication production service system is based on an integrated system design, making maximum use of advanced computation equipment in a unique production and control sense. The concept is so structured and the computer equipment would be so selected that the evolutionary steps could take place with maximum facility.

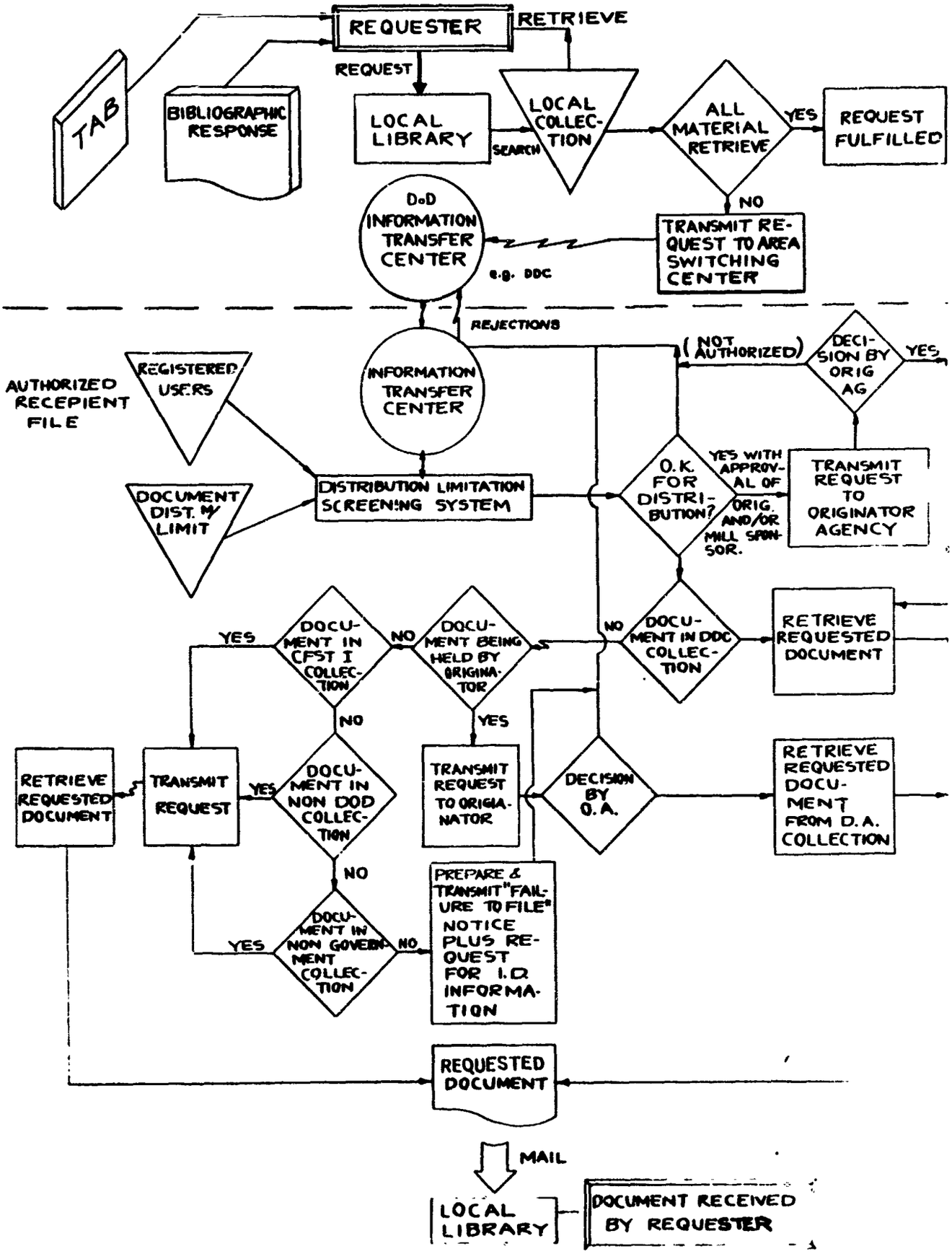
In the concept described, the data processing and computer capacities at DDC would be incorporated into the integrated system design as a true production machine, rather than a mere computational or compiling device. It is only through this type of computer usage that the integrated system concept described above becomes operationally practicable. The described production system also exploits the use of the computer as a control device, using it to control traffic between production steps and to trigger activities within production units. With such a system concept, overall system optimization can become a reality.

2.8.4 Hard-copy request process

It is appropriate at this point to discuss the method of hard-copy procurement in the context of a centralized distribution system, or an automated publication production system, as described in the two preceding sections. Although it is evident that a centralized distribution system would mak it easier to procure documents than it is currently, a brief explanation of the process is necessary.

Figure D-5 "DOD Hard-Copy Request Process - 1971," describes the major elements involved in procuring hard copy, assuming a centralized store and the utility of ITC's. As shown on the figure, the requester derives a requirement as a result of his review of the announcement and bibliographic services. This request is transmitted to the local library where the local collection is searched in an attempt to fill the request. Assuming the request cannot be filled locally, it is transmitted to the AITC and subsequently relayed to the central store. The flow chart which appears below the DOD ITC is actually a logical process which is a combination of both man and machine decisions. This brief flow chart shows the method of ascertaining approval and authority for dispatching the requested material as well as feedback to the requester in the event the request cannot be filled.

The flow chart of Figure D-5 is far from a complete analysis of even the broad functions performed by a centralized system. This is obvious since the logic flow deals primarily with authorization, distribution, and availability limitations. In addition, the flow chart makes no reference to the five other data banks utilized in a central system as discussed in Paragraph 2.8.2 above. It is interesting to note that on a decentralized basis all of these functions would be duplicated at each centralized center. However, this statement does not preclude the possibility of decentralization since the workload could be divided up



DOD HARD COPY REQUEST PROCESS 1971

Figure D-5

between the central and decentralized stores. For example, the more involved functions should be performed centrally and relayed by telecommunications to the various ITC's where the less involved and localized functions take place. The primary function of Figure D-5 is to demonstrate the overall complexity, and it is not intended to give even a brief treatment of the total processes involved.

2.8.5 Curtailment of distribution volume

To aid the use in coping with the unrealistic magnitude of technical material he must read, an effort could be made to curtail the volume of full-text material he receives. This may be possible by requiring that all significant elements of every STINFO report be condensed into two pages. If only these pages plus the title page are distributed, the information needs of a very large percentage of the recipients will be satisfied. This so-called "extended abstract" can be so densely packed with information that it will effectively communicate the essence of the report which, in most cases, is the outcome of disseminating the full text. There are severe humanistic limits to the amount of information a person can use; this limit is small compared to the amount of information available.

It is necessary for the knowledge of the contents of documents to be transmitted to prospectively interested technical people; it is not absolutely necessary that the entire document be transmitted to all potentially interested persons. Indeed, the percentage of documents read cover-to-cover by professional engineers and scientists is quite small — approximately 10 percent on the average. Most of these professionals merely scan the report or select sections which appear of interest from an examination of the table of contents.

Furthermore, this extended abstract approach will provide the following advantages:

(a) It would enable the user to make a far more accurate judgement as to whether he wants the full text than he can presently gain from a review of the abstract.

(b) Since microfiche is not utilized in this concept, it would eliminate the need for the user to read from a viewer. Microfiche is, in reality, not a totally acceptable means of reading a document. Coupled with equipment costs, it may not be a realistic method of conveying printed information to the user on an overall broad basis.

(c) It could provide the user with a convenient filing medium if the 2 to 3 text pages are produced on tab size cards in a reduced but eye-readable form.

(d) It would, with the use of standard punched cards, facilitate the handling and distribution of the material by means of existing economical sorting mechanisms.

(e) It would have a tremendous potential for dollar savings effected by significant curtailments of printing volume, handling, packaging, mailing and consumption review time expended.

(f) It would provide, for the first time, a very workable and effective approach to solution of the critical problem currently facing the DOD/RDT&E scientist or engineer, namely, how to keep abreast of technical developments in, and associated with, his technical field when the sheer volume of material to digest is clearly beyond the scope of his capabilities.

2.8.6 Man-machine interaction

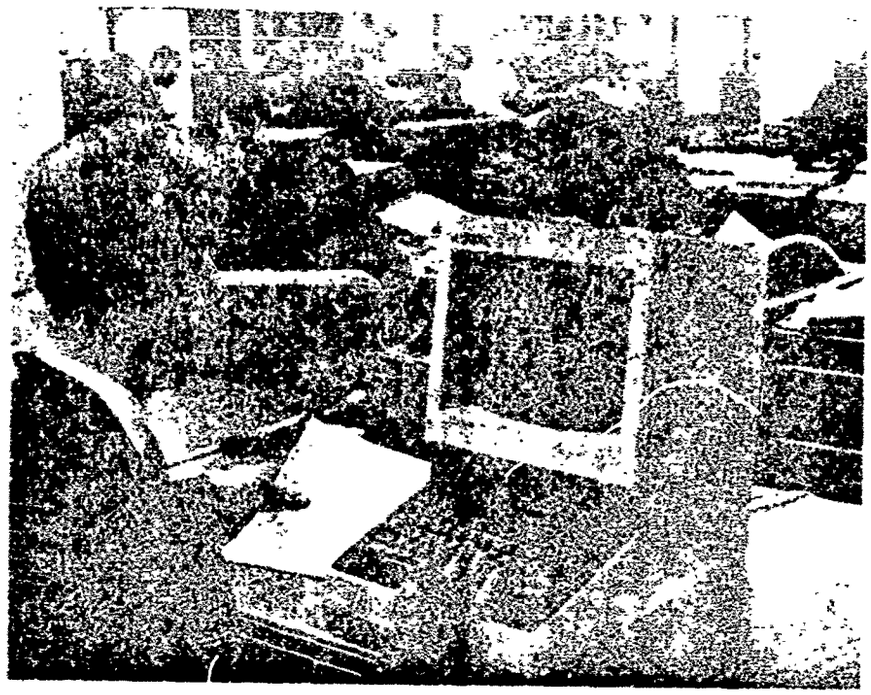
It has been determined, from other studies, that users rely heavily on the informal (local) information systems which

provide convenience, responsiveness, and the ability to conduct a dialogue or interplay. This feedback is exceedingly important to the information transfer function. The user wants to have the ability to explain, clarify, and modify his requirements. In order to close the gap between the question and the answer - between the desired information and the existing file - it is essential to carry on a two-way interplay between the searcher and the data file. The resulting feedback refines the question which is resubmitted repeatedly until the desired information is found. This capability is a significant element in the design of an effective information retrieval system.

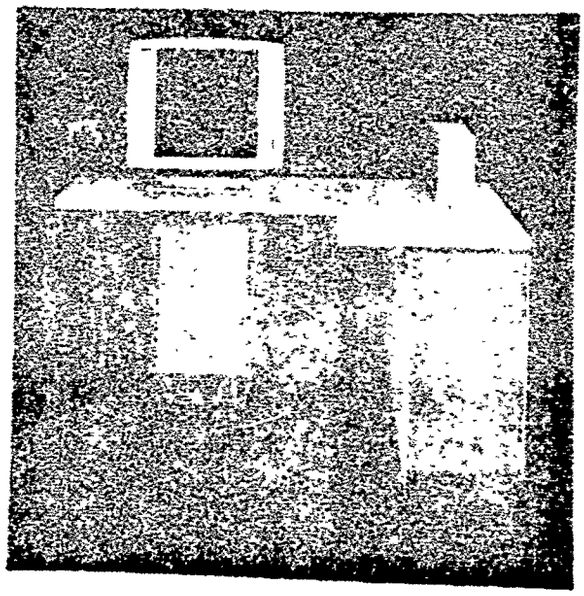
In order to derive the information required, carry on the dialogue, and even provide a browsing capability directly with the machine-stored file, a man-computer interaction must take place. This can be performed by what is known as a cathode ray tube (CRT) console display. The main requirement is for an inexpensive device that will display alphanumeric text, approximately a page at a time, and at a pace consistent with rapid reading. There is an additional need for the display of graphics such as drawings, graphs, diagrams, and to a lesser degree, photographs.

It is generally agreed that utility of consoles at remote locations is an absolute necessity for an effective information transfer function. Currently, the main problem is one of cost. However, as the need for such equipment grows, the mass production costs inevitably will be reduced. There are currently a number of such types of equipment on the market. Although the widespread use of CRT display equipment is probably a few years off, the technical problems involved in providing most of the information desired at remote stations have been overcome. Figure D-6, "Typical CRT Display Station", shows a new display station which is one of the standard input/output devices for the IBM 360 computer.

The interaction problem involves more than just a display by the computer to the user. There must be a method for the user to communicate with the computer to complete the circuit. This is accomplished in one of two ways. The standard method is a keyboard of alphanumeric characters upon which data may be manually entered. A second and even more convenient device for communication from the user to the computer is the light pen that operates in conjunction with displays on the CRT. The light pen constitutes a very powerful tool in the man-machine information interaction.



The new IBM 2260 display station provides a visual image of computer-stored information



- 3848 characters can be displayed simultaneously in 52 lines with 74 characters per line.
- A 4K or an 8K buffer regenerates the character image.
- Data is entered manually from one of three sources:
  the alphameric keyboard of an IBM 1052 Printer-Keyboard; Program Function Keyboard; or a hand-held Light Pen Device.
- Manual display units may be located up to 2,000 feet from the computer.

TYPICAL CRT DISPLAY STATION

Figure D-6

Figure D-7 , "Man-Machine Interface", displays the method by which the man-machine interaction might take place. A bibliographic request would first have to be indexed in some fashion, and then a key-in request to the proper data bank would be made. As a result of this query, a computer file remote from the key-in station would be searched and the appropriate information retrieved. This response would be displayed on the CRT in the form of a request for refinement of the index terms if the number of drops are excessive. This, of course, implies that the terms were too broad. The computer could then analyze the type of drops and recommend specific retrieval terms to satisfy the request. The requester absorbs this information and keys in a new request which, again, goes to a remote file for retrieval. The response comes back again on the CRT as a request for further refinement of the index terms. This process can continue until the requester decides that the type and quantity of bibliographic material indicated by the CRT display is what he desires. He then initiates a retrieval action.

After a relatively short period of time, the CRT will begin to display bibliographic reference material in the form of titles, citations, and location of the bibliographic item. These items would cross the screen in a speed controllable by the reader. As the requester identifies items of interest, he makes a proper notation; when the bibliographic reference material is finished, he can key in a request to an adjacent file which will automatically retrieve microfiche containing full-text material of the documents he desires. This, of course, assumes that the local file contains all of the subject material that the requester might conceivably desire. Since most RDT&E organizations are discipline-oriented, this is not an unreasonable requirement.

It is possible to envision an alternative CRT display which would be of more value to the user, especially if he did not have available locally the material that he needed or if he decided that, rather than full-text material, his needs could be satisfied with segmented portions of the full text. The alternative display would have the same bibliographic material mentioned earlier and would also include a breakdown of the segmented portions of each document. The user could then utilize a light pen selector and touch the appropriate "dot" adjacent to the item desired to request either the entire document, the abstract plus table of contents, the conclusions, the recommendations, or the bibliography. By touching the light pen to any one of those items, he

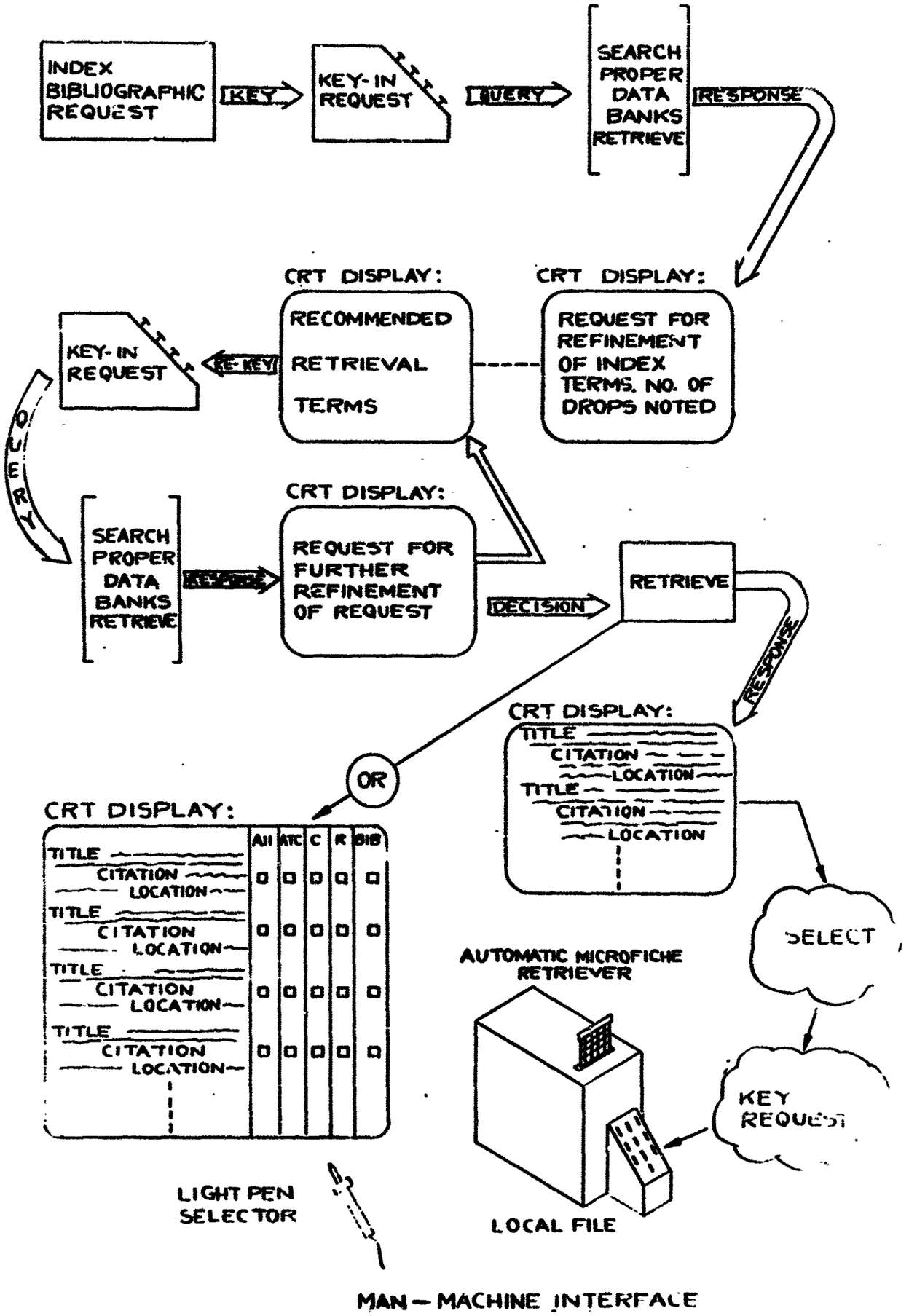

INDEX BIBLIOGRAPHIC REQUEST
KEY
KEY-IN REQUEST
QUERY
SEARCH PROPER DATA BANKS RETRIEVE
RESPONSE
CRT DISPLAY:
RECOMMENDED RETRIEVAL TERMS
CRT DISPLAY:
REQUEST FOR REFINEMENT OF INDEX TERMS. NO. OF DROPS NOTED
KEY-IN REQUEST
RE-KEY
QUERY
SEARCH PROPER DATA BANKS RETRIEVE
RESPONSE
CRT DISPLAY:
REQUEST FOR FURTHER REFINEMENT OF REQUEST
DECISION
RETRIEVE
RESPONSE
CRT DISPLAY:
TITLE
CITATION
LOCATION
TITLE
CITATION
LOCATION
OR
CRT DISPLAY:
All ATC C R BIB
TITLE
CITATION
LOCATION
TITLE
CITATION
LOCATION
TITLE
CITATION
LOCATION
TITLE
CITATION
LOCATION
SELECT
AUTOMATIC MICROFICHE RETRIEVER
KEY REQUEST
LIGHT PEN SELECTOR
LOCAL FILE
MAN — MACHINE INTERFACE

Figure D-7

would automatically trigger a retrieval mechanism which would send to him the indicated document or segmented portion.

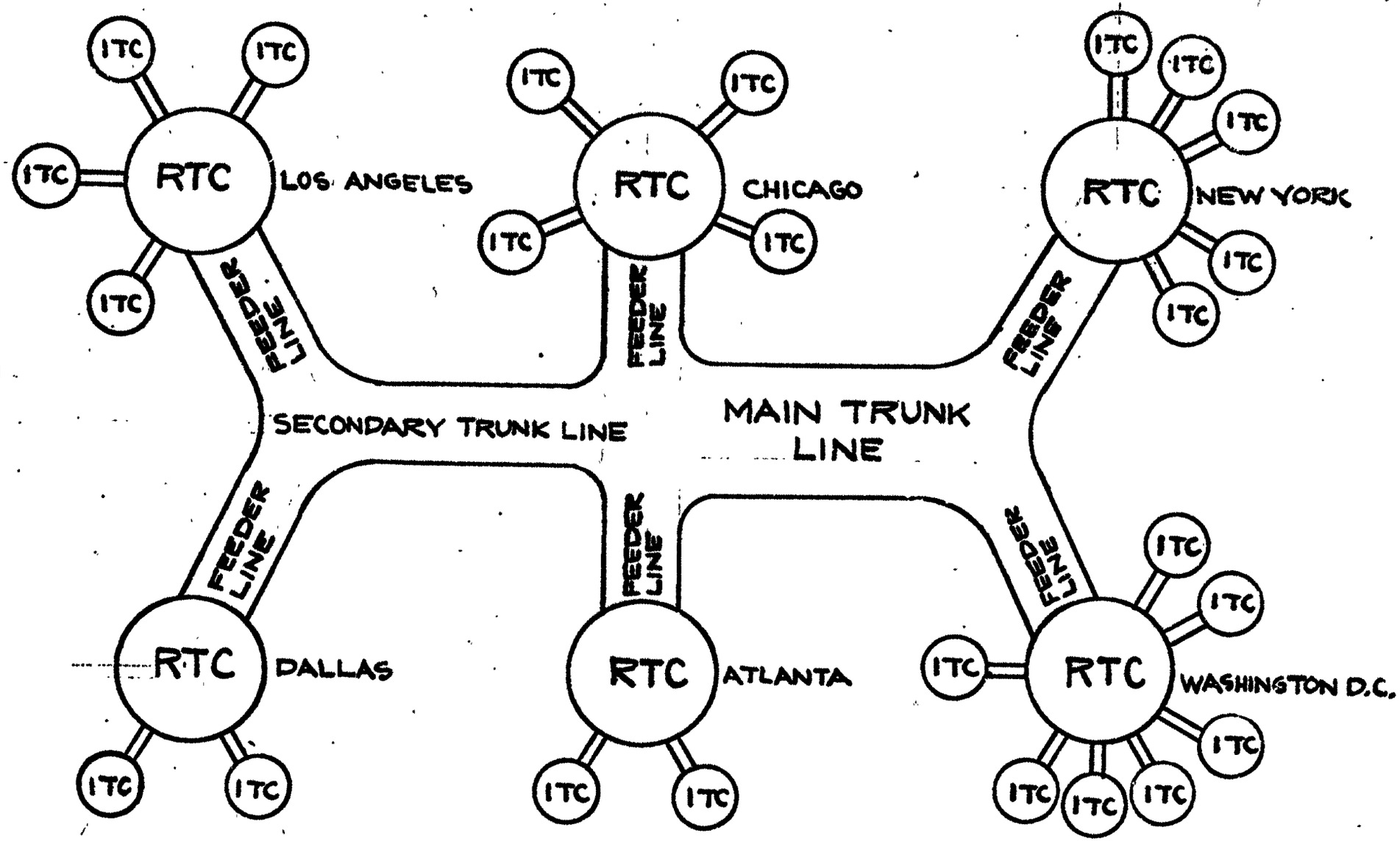
There are many problems yet to be resolved in the man-machine interaction area. The utility of such consoles will become more popular as these problems are solved. It is believed that they will be solved and that the use of consoles during the next five years will become a major and important element in the information transfer process.

2.9 Integrated Defense Information Network Concept

There are frequently no simple solutions to complex problems. The DOD/RTD&E STINFO problem is certainly a very complex problem. It logically follows, therefore, that the solution to this problem will also be of a complex nature. As obvious as this may sound, it is not apparent to many system designers who propose simplified solutions to the overall problem. The only approach that really makes sense is to have an overall long range plan (complicated as it may be) and to implement this plan in an evolutionary manner, one simple step at a time. This concluding section of major overall system concepts is intended to summarize the various concepts described above in an attempt to take a projected view of the ultimate integrated DOD/RDT&E STINFO network.

A full description of the major elements and activities of a total network would be redundant since all of the major elements have been previously discussed. Instead, this description will concern the overall concepts of a Defense Information Network (DEFINET). A conceptualized diagram of a national information network is shown in Figure D-8 "Defense Information Network (DEFINET)". As shown on the figure, it is envisioned that there would be approximately six regional transfer centers located at six major cities throughout the United States. Connected to each of these regional transfer centers is a group of information transfer centers. As described earlier, the network concept in reality is a system of systems. Each information transfer center performs very specific functions in fulfilling its part in a comprehensive Defense Information Network.

DEFENSE INFORMATION NETWORK (DEFINET)



RTC = REGIONAL TRANSFER CENTER

ITC = INFORMATION TRANSFER CENTER

Figure D-8

A brief summarization of the major elements in the envisioned DEFINET is as follows: DEFINET is composed of interconnected Regional Transfer Centers (RTC) each connected to a group of Information Transfer Centers (ITC) each functionally designed to maintain detailed disciplinary-orientated data banks many of which are tied in with specialized Information Analysis Centers (IAC). Each contains, in addition, interdisciplinary classification data banks and is strategically located through an area/discipline overlay technique. Also, each ITC performs an information locator function as well as an information transfer function through the national integrated communication network.

This description of the information network is a synthesis of the approaches stated above related to information management. Nothing, as yet, has been said about document management. The concept of centralized distribution and centralized automated publication production have been discussed earlier; these are the direction in which the document management approach is likely to go. It is possible that a decision could be made to decentralize operations and allow the RTC's to perform a distribution function (hard copy and/or microform) as well as the information transfer function. However, it appears that a centralized automated publication production and integrated service system is the direction in which decisions to enhance the document management problem will go in the next five years.

Figure D-9 , "Salient Features of The DEFINET Concept", is a brief outline of the information management approach envisioned toward solving the overall DOD/EDT&E STINFO problem. The foregoing analysis represents a foundation upon which detailed plans can be formulated to implement the first stages of a DOD Defense Information Network which ultimately will resolve the information problems and result in effective dissemination of STINFO throughout the RDT&E community.

- DEFENSE INFORMATION NETWORK (DEFINET)
  is composed of inter-connected
- REGIONAL TRANSFER CENTERS (RTC)
  each connected to a group of
- INFORMATION TRANSFER CENTERS (ITC)
  functionally designed to maintain detailed
- DISCIPLINARY-ORIENTED DATA BANKS
  tied in with specialized
- INFORMATION ANALYSIS CENTERS (IAC)
  and each ITC containing interdisciplinary
- CLASSIFICATION DATA BANKS
  strategically located through an
- AREA/DISCIPLINE OVERLAY TECHNIQUE
  also each ITC performing an
- INFORMATION LOCATOR FUNCTION
  and an information transfer function through a
- NATIONAL INTEGRATED COMMUNICATIONS NETWORK

Figure D-9 SALIENT FEATURES OF THE DEFINET CONCEPT

3. CONSTITUENT SERVICE CONCEPTS

3.1 Introduction

The foregoing discussion under Section D.2 presents several possibilities for future RDT&E scientific and technical information service systems in which DDC may become a participant. The particular system or network configuration which evolves will ultimately determine major priorities, workloads, and specific characteristics required of information processing activities carried out at DDC. However, the particular direction that the RDT&E STINFO service network development will take in the next five years is not now known.

The present planning effort is, therefore, necessarily limited to consideration of a projection of the continuance of present services, plus the addition of new services that appear to be needed and, therefore, are likely to become constituent services regardless of the larger scale system configuration. To the extent that planning resources and capabilities of the methodology permit, the effect of any new services could also be analyzed and integrated into overall plans at any time.

The description of service concepts will be approached by first describing in a very brief manner the current DDC services. Then, the projected DDC services will be briefly listed. Subsequently, each of the projected DDC services will be discussed and a preliminary analysis and suggestion made as to whether or not the projected service is one that DDC should adopt immediately, discard entirely or resolve by further study.

Before discussing any of the current or projected services, it is necessary to describe briefly the meaning of certain key terms used in stating the concepts. The term "automatic distribution" refers to an initiative action on the part of DDC that does not require a corresponding action on the part of the receiver for each item received. The term "on-demand distribution" is a responsive action that does require a specific request from the recipient for each item dispatched.

Two new terms will be referred to in the discussion of projected DDC services, namely, "segmented" and "truncated." The term "segmented" refers to a separable portion relatively self-supporting for its intended purpose in a technical report presentation. This term implies that the original document has been reproduced in such a way as to make it possible to distribute parts of the whole. The term "trun-

cated" refers to a more general concept of compressing the description of the document contents into a significantly smaller volume of text than appears in the original document. This concept includes such methods of achievement as random sampling of the document or abridgment of the document into a condensed version. In either case, the truncation would allow the reviewer to become more aware of the contents of the document than is possible from the short abstracts now appearing in TAB.

3.2 Current DDC Services

The following 15 services are provided by DDC to authorized DOD organizations, other government agencies and qualified contractors and grantees. This list of current services does not include internal processes and procedures which do not interface with the user.

3.2.1 On-demand distribution of technical reports in hard copy

DDC processes and disseminates only those DOD reports which have security and/or distribution limitations. The remainder are forwarded to the Clearinghouse for Federal, Scientific and Technical Information (CFSTI) where they are processed and subsequently distributed. During FY 1965, slightly over 1.5 million requests for documents were received. Of this, approximately 1.3 million requests were filled (89 percent of total requests). Of this total 1.2 million hard copies were supplied and over 113,000 microforms. DDC's share of this total amounted to 677,000 requests filled. Of this total over 632,000 were filled with hard copies and nearly 45,000 with microform blowbacks. Fifty percent of the hard copies (original or multilith) shipped in FY 1966 were filled from shelf stock in an average of 2.1 workdays. The remaining fifty percent were filled from reproduction processes (multilith, Xerox blowback, or microfiche blowback) in an average of 6.1 workdays. Considering just the advent of automatic distribution of microfiche, it is expected that the total requests for secondary distribution of technical reports will level off at approximately 1.0 million annual requests in the next five-year period.

3.2.2 On-demand and automatic distribution of technical reports on microfiche and roll film

During FY 1966 about 2.8 million microfiche were distributed. This number is expected to reach nearly four million in

FY 1967 and over six million in FY 1968. Within five years it is anticipated that over ten million microfiche will be distributed annually.

3.2.3 Automatic distribution of hard-copy announcement journals

DDC prepares bi-monthly the Technical Abstract Bulletin (TAB) where over 50,000 accessions to the DDC collection are announced annually. TAB is published external to DDC and distributed by GPO in accordance with DDC mailing labels and instructions.

3.2.4 Automatic distribution of hard-copy book-form indexes

As a supplement to TAB, DDC publishes bi-monthly, and cumulated quarterly and annually, five indexes: subject, corporate author-monitoring agency, personal author, contract index, and report number. These indexes are published together bi-monthly and separately on a quarterly and annual basis.

3.2.5 On-demand bibliography searches and high-speed computer printout (hard copy) of lists with abstracts

DDC prepared over 17,000 bibliographies in FY 1966 of which 99 percent were computer-produced. An average of 137 citations were furnished with each bibliography shipped; the processing time averaged 3.3 workdays. It is expected that requests for bibliographies will continually increase, reaching over 40,000 per year in the next five years.

3.2.6 Management reports in response to query of 1948 data bank

During the first seven months of operation, DDC received and processed nearly 1,000 requests for work unit data. This figure is expected to reach 4,000 to 5,000 in FY 1967 and practically double each year thereafter, reaching approximately 40,000 in the next five-year period.

3.2.7 Selective dissemination of information: distribution to user points of microfiche in complete subject sets

This is currently an experimental service. It is expected that in FY 1967 approximately 300,000 microfiche correlated in-

to "requests for proposals packages" will be disseminated. It is further anticipated that this demand will grow to 1.5 million annually in the next five-year period. Other estimates have placed this figure at nearly 18 million microfiche in less than a five-year period if the service is fully implemented. Decentralized operation of this service is being considered.

3.2.8 Automatic distribution of bibliographic file data on magnetic tape

This service is currently in an experimental and study status. It also involves exchange of magnetic tapes with other agencies.

3.2.9 Primary distribution of hard-copy foreign reports

During FY 1966 over 3000 hard-copy foreign reports were distributed. It is expected in FY 1967 that this figure will soar to nearly 50,000 per year and level off thereafter at about 58,000.

3.2.10 Service assistance by DDC field offices permitting on the spot printouts of pages plus document review by users

There are currently five such field offices located in Boston, Dayton, Los Angeles, New York, and San Francisco. The need for continuation of these offices is now under study by DDC.

3.2.11 Continuous telephone referral service for special information

This is an important and direct service to the user in the form of document identification, acquisition, and referral.

3.2.12 Maintenance of the central registry of authorized users with capability for automatic pre-notification of authorization expiration

This essential function controls the dissemination of information to ensure authorized receipt of classified and/or limited documents.

3.2.13 Automatic dissemination of service publications

This includes, for example, the DDC Digest which is prepared and published at DDC at an approximate volume of 15,000 per month.

3.2.14 On-demand management reports from the Contractor Performance Evaluation (CPE) and Contractor Cost Reduction (CCR) report files

In FY 1966 approximately 400 such requests were processed. It is expected that within a year or two the requests for CPE and CCR reports will level off at approximately 1,000 per year.

3.2.15 Vocabulary control (Thesaurus) and distribution

DDC prepares authoritative terminology tools and rules, thereby controlling the storage and retrieval language necessary to efficient retrieval of bibliographic data. The DDC Thesaurus is a service tool of fundamental importance. A DOD-wide Thesaurus is currently being developed under Project LEX and is expected to result in an expanded Thesaurus maintenance workload for DDC in this area.

3.3 Projected DDC Services

Additional service concepts considered as candidates for DDC activities are described in two sections. This Section 3.3 is a listing of the projected service concepts. Under Section 3.4 each of the service concepts is discussed in additional detail. A preliminary analysis is made as to whether these concepts are to be recommended for immediate implementation, not recommended at all, or recommended for further study.

3.3.1 TAB on microfilm

Periodic (annual) production and distribution of complete announcement journal citations (with abstracts) and complete indexes (subject, corporate author-monitoring agency, personal author, contract index, and report number) on micrographics (e.g., roll film cartridges).

3.3.2 State-of-the-art packages

On-demand distribution of full text reports on micrographics (e.g., microfiche) collated into subject sets for state-of-the-art reviews.

3.3.3 Task-oriented sets

On-demand distribution of full text reports on micrographics (e.g., microfiche) correlated by task-oriented sets.

3.3.4 Higher quality and use of micrographics

Authority and encouragement of technical report producers to produce and meet primary distribution needs for microfiche at or near the source of production.

3.3.5 RFP packages

On-demand distribution of full text reports on micrographics correlated by subject sets for RFP packages.

3.3.6 Research-in-progress indexes

On-demand distribution of research-in-progress hard-copy indexes for scientific and technical purposes by: subject index including abstract, corporate author index, and technical-personnel-involved index.

3.3.7 Capabilities listing

On-demand (authorized) distribution of hard-copy listings and maintenance of a centralized registry of "Contractor Technical and Production Capabilities Listing."

3.3.8 Mechanized CPE/CCR data banks

On-demand computer-generated management reports from mechanized CPE and CCR data banks.

3.3.9 Truncated announcements

Automatic distribution of some type of truncated technical reports in hard-copy as part of announcement packages to improve the depth of the description and thereby clarify the likely utility of the report contents.

3.3.10 Segmented reports

On-demand distribution of segmented technical reports in hard copy.

3.3.11 Segmented TAB

Selective automatic distribution of segmented (by subject field) announcement journals and cumulative indices in hard copy and on micrographics.

3.3.12 Extension of D&I input modes

Maintenance of comprehensive bibliographic indexes and inventories of technical information other than reports, such as: charts, maps, graphs, technical books, drawings, periodicals, pamphlets, catalogs, dictionaries, technical motion pictures, directives, specifications, standards, patents, handbooks, test programs and monographs.

3.3.13 Distribution of extended modes

On-demand distribution of same items as in paragraph 3.3.12 above on microfiche, microfilm, aperture cards, photographic chips and strips, other microforms, or hard copy, as appropriate.

3.3.14 Centralized control of primary distribution

A centralized record maintenance function that combines, to the extent possible, record keeping and material handling of both primary and secondary distribution functions.

3.3.15 General observations

Before each of the above projected service concepts are described and analyzed, it is necessary to make several general

observations. An important question arises as to what relative role, in a realistic sense, will three major modes of graphic record communication have in the future with respect to the physical form of the final product provided the customer. The three major forms, microfiche, roll film (cartridge form), and hard copy, can play individual but compatible roles which would collectively satisfy user requirements in an efficient and effective manner. There are three major precepts upon which the following projected services are based. It is felt that these precepts are fundamental in using the three main graphic record media in producing products for future information services. The precepts are:

(a) For announcement journals, whether in full text, segmented, or truncated versions, the primary mode of communication has been and probably should always be hard copy.

(b) The most efficient storage medium for reports, and segmented or truncated versions of reports, is microfiche.

(c) For storing or transmitting these products having many cumulative pages (for example the complete TAB and TAB Indexes) microfilm (roll film) is a highly desirable storage medium.

3.4 Analysis of Projected DDC Services

3.4.1 TAB on microform

The sheer volume of TAB and the various TAB Indexes makes it a likely candidate for use of micrographic media. The storage and use of such volumes of material could be significantly enhanced through the application of 16 mm roll film cartridges. The use of either manual or automatic page-finder microfilm reader/printer equipment can provide a fast method of locating the desired information. Cumulative annual indexes, in particular, due to their bulk are good candidates. These are seldom distributed internally by user organizations, but are, rather, kept in technical library locations. Since this material is currently utilized in the library, it would be feasible to implement a system displaying cumulative indexes and abstracts on microform. Though it is questionable that users will prefer to use the

TAB Indexes on microform rather than hard-copy, their preferred use of cumulative displays of abstracts in AD number order appears certain. This could be produced on roll film by use of available equipment directly from magnetic tapes used to produce TAB.

The concept of placing TAB itself (both citations and abstracts) on microfilm cartridges opens up an entirely new convenience to DOD users. Users could find the reference in one of the indexes and have immediate access to the roll film cartridges, located adjacent to the indexes, containing the abstract and citation of the document. It may even be advantageous to combine more than one year of TAB in sequence on the roll film for cartridge use; this would reduce retrospective search time in retrieving citation and abstract information. This projected service concept is included in the five-year plan alternatives.

3.4.2 State-of-the-Art Document Packages

Another projected service concept relates to on-demand distribution of full-text material in micrographic form correlated by subject sets as a current state-of-the-art collection. This service concept involves significantly more than a modified version of the current bibliographic search process. An effective state-of-the-art review must include an information evaluation and selection function by subject experts. This service could be a cooperative extension of the present service of providing computer-generated state-of-the-art bibliographic lists, in combination with evaluation functions of the Information Analysis Centers (IAC). As envisioned here, the state-of-the-art package:

(a) Provides full-text on microfiche to the requesters for the service.

(b) Provides a hard-copy index to the microfiche package for use by the requesters.

(c) Represents the most authentic and condensed set describing the state-of-the-art in a selected field, since the items selected are a result of the intellectual effort of evaluation.

It is logical that the evaluation and selection function could be performed by the subject experts currently located at the IACs (as well as other places). One method of effecting such a service would

be to provide a complete subject bibliography to the individual IACs. After their review of the bibliography, full-text hard-copy reports can be forwarded in bulk to the IACs. The experts at the IACs could perform the state-of-the-art review thereby identifying the salient and current information.

In addition, DDC could provide users with continuous updating service so as to maintain the availability of current state-of-the-art packages. Although there are other methods by which this service could be performed, it is clear that DDC could immediately consider the possibility of providing such an expanded service to its users.

3.4.3 Task-Oriented Sets

Another service concept is the provision of on-demand full-text microfiche report packages correlated into task-oriented sets. One existing source of information essential for the task-oriented sets would be derived from the 1498 data bank. It is envisioned that the descriptors on the 1498 could also be expanded to be more inclusive and descriptive of the project. With such information, bibliographic search runs could provide definitive task-oriented sets of microfiche directly related to objectives and problem statements of the task and the technology to be used in developing problem solutions. In reality such a service is both initiative and responsive. It is responsive in the sense that it responds to the initial request for task-related information; it is initiative in the sense that the service continuously monitors incoming accessions to the DDC collection to determine their relevancy to each task or project reported on the 1498 submissions. This service could continue through the duration of the task. DDC could take early steps to provide such a service for its users. It is included in the plans presented herein.

3.4.4 Higher Quality and Increased Use of Micrographics for Technical Report Distribution

Preparation of microfiche masters at or near the source of origin would result in a significant improvement in the quality of the micrographic product ultimately delivered. The need for improvement in the quality of the micrographic masters has been long recognized. The problem results from the poor quality of the material shipped to DDC for microfilming. One solution to this problem is to prepare the micrographic master at or near the source directly from the original graphic material. The large technical report producers who have the capability, if allowed and encouraged, would prefer to produce the microfiche masters either at their own facilities or at a nearby regional center providing such

services. This master could subsequently be transmitted to DDC for reproduction and primary as well as secondary distribution.

The resulting image quality of the product ultimately delivered to the user would be high. However, the policy changes required to implement such a service concept require additional study to verify its feasibility and to plan for the cooperation that would be necessary for its success.

3.4.5 RFP packages

The on-demand distribution of full-text microfiche correlated by subject sets for RFP packages is currently in an experimental stage. The service will not only provide equal availability of documentation to all contractors but could have a significant effect on the cost of many contracts. Despite one estimate that the annual requirement would approximate 18 million microfiche, costing 1.8 million dollars for reproduction alone, to satisfy these RFP program demands, it appears to be a worthy service concept. It is included in projected plans.

3.4.6 Research-in-progress indexes

In order to minimize the effect of the long time delay between project completion and eventual receipt of documents through the secondary distribution function, information regarding work-in-progress could be disseminated at the time work is under way. The on-demand distribution of research-in-progress hard-copy indexes would not only close this time gap but would be an effective method of informing decision makers about to begin new research efforts whether or not similar efforts are under way. The three indexes that could be provided are: subject index including abstracts, corporate author index, and an index of chief technical personnel involved. The latter index could also serve the function of providing a registry of experts in specific fields. The indexes would probably further result in a decrease in secondary distribution volume and an increase in primary distribution volume. This is likely since the interested recipients will be made aware of the forthcoming issuance of the document and will request it be sent to them at the time of initial publication. In this way a large percentage of what might have been secondary distribution would be absorbed in the primary distribution stage. Such a group of indexes would have high value in the DOD/RDT&E community. The service concept is included in projected plans.

3.4.7 Capabilities Listing

It is anticipated that DOD will eventually implement a centralized registry containing technical and production capabilities of each of the DOD contractors. Such a registry could have a major impact on the efficiency of the technical procurement process. It is reasonable to assume that DDC is a likely choice for the ultimate location of such a data bank. The maintenance of a centralized registry together with the on-demand distribution of hard-copy listings ("Contractor Technical and Production Capabilities Listing") is an attractive service concept. It is included in projected plans considered in this report.

3.4.8 Mechanized CPE/CCR data banks

The CPE/CCR reporting system is operated by manual means. The activity of this data bank is currently quite low. However, it is envisioned that request traffic on this management information bank will increase. In order to move toward a fuller management information system capability, DDC could mechanize the CPE/CCR data banks. This is considered in the projected plans.

3.4.9 Truncated announcement

This concept involves automatic hard-copy distribution of one of several forms of truncated technical reports as part of the announcement package to improve the depth of description of report contents . It is currently believed that an unrealistic volume of full-text technical material is being requested by most users. If the user can be better appraised of the contents of the material at the time of announcement, he should be able to make a more discriminating selection of material pertinent to his needs.

The concept of truncation addresses itself to the problem of improving the announcement process. The use of the abstract has only partial effectiveness as a method for transmitting information regarding the content of technical reports. There are many approaches to the subject of effective truncation; several of these alternatives deserve evaluation. For example, full-text or truncated subject sets on microfiche could be provided with TAB. An even better possibility would be to select four representative pages from the document and print these four pages on each quadrant of an 8-1/2 by 11 sheet of paper. It has been calculated that this process would result in an average of 100 pages per major DDC subject field. This could be published at the same intervals

as TAB. Instead of TAB being distributed to individuals, the user could receive his selected subject-field booklets containing the truncated versions (four pages each) of the reports in his field of interest.

To aid the user in coping with the unrealistic magnitude he must read, a conceivable effort could be made to curtail the volume of full-text material he first receives. This could take the form of requiring that all significant elements of every technical report be condensed into two pages. If only these pages plus the title page were distributed in full size, the information needs of a very large percentage of the recipients might be satisfied.

Although the need for a step in this direction appears necessary, additional information is needed to determine whether it is advisable to employ some form of report truncation. A study should first be conducted to determine the motivation behind the bulk of present request activity. Before investing any resources in restructuring abridgments or condensation, it must be determined if such a service concept will work to advantage. Since the service of providing full-size hard-copy is free, users may not acknowledge a system providing them with short form documents anyway. If a charge were established for full-size hard-copy, it is probable that users would be much more discriminating in their ordering decisions. However, this would require major policy changes. Before a truncation approach can be recommended or implemented, studies should first be undertaken to determine its feasibility.

3.4.10 Segmented technical reports

This concept aims to provide the user with only building-block informational elements of the technical report he requests, rather than the entire document. The concept of segmentation involves subdividing a document into definable prescribed portions. The concept requires that the original hard-copy be microfilmed in such a manner as to make it possible to distribute parts rather than the whole report. It has been suggested that the document could effectively be broken up into six parts, for example:

(a) Abstract and Table of Contents
(b) Background and Purpose of Report
(c) Technical Approach and Problems Encountered
(d) Conclusions (or Significant Findings)
(e) Recommendations
(f) Bibliography

In order for the concept to work, it would be necessary for DOD to require that all technical reports emanating from the RDT&E process be structured according to a prescribed format. Only this way could the original document be microfilmed with appropriate markings defining each of the six sections. Selected portions of the microfiche, blown back, could then be mailed to the requester.

This concept is based upon the assumption that most of the recipients are not interested in receiving the entire text. In a very large percentage of the cases, a portion of the text (and probably a very small portion) will possibly satisfy the requester and will accomplish essentially the same result as the full text. This concept, it is suggested, might reduce the volume of hard-copy distributed to users without reducing the effectiveness of communicating information from producer to user. Conceivably it could reduce the volume of material distributed to the level that the user can realistically use.

Assuming the technical feasibility of this concept were shown, the economic segmented portions on individual microfiche rather than blow-back hard-copy is questionable. Although it is possible, it appears to be uneconomic because it would be nearly as expensive to send a portion of the text on microfiche as it is to send the entire document on microfiche. This, plus the costs involved in providing adequate reading devices for the users, precludes this version of the concept from further consideration.

DDC TASK FORCE Recommend segmentation of reports be accepted by subject content and made for a subject (many reports be listed)

Although this concept may have appeal to those responsible for report reproduction and distribution, it has highly questionable technical feasibility. In order for the concept to work, it must be required that all technical reports emanating from RDT&E activities be structured according to a specific format. This is where this concept is considered technically unfeasible. Within DOD the types and purposes of technical reports vary to such a significant degree that such a formalized structuring to cover all technical reporting throughout DOD is judged an unfeasible requirement. The service concept is therefore not included in projected plans.

3.4.11 Segmented TAB

This concept involves the selective, automatic distribution of TAB and TAB cumulative indexes segmented and organized by subject field. Such segmentation could be distributed in either hard-copy or micrographic form. This concept would require the creation of

22 separate indexes, one for each DDC subject field. Although there are many users interested in only a portion of TAB, it is clear that many user organizations will still require the full set of abstracts and TAB indexes. Production of TAB and the indexes as they currently exist would have to continue. In addition, users would desire various combinations of coverage in the subject indexes, thereby presenting a very perplexing problem in the method of breaking up the indexes. For these reasons this service concept is not included in the projected plans.

3.4.12 Extension of D&I input modes

The RDT&E community requires access to more technical information than is available from DDC technical service reports. To serve the informational needs of RDT&E users adequately, it may some day fall to DDC to consider the inclusion of services concerned with charts, maps, graphs, technical books, drawings, periodicals, pamphlets, catalogs, dictionaries, technical motion pictures, directives, specifications, standards, patents, handbooks, test programs and monographs. Maintenance of comprehensive bibliographic indexes that inventory this material may some day be kept. The administrative, legal and budgetary aspects of implementing such comprehensive services as implied in this concept would have to be carefully studied. For these reasons the service concept is recommended for study in the projected plans.

3.4.13 Distribution of extended modes

This concept involves providing physical access or secondary distribution of the same D&I items listed in paragraph 3.4.12 above on microfiche, microfilm aperture cards, photographic chips and strips, and other microforms or hard-copy as appropriate. Identical comments apply with respect to the need for study before further consideration in DDC planning.

3.4.14 Centralized control of primary distribution

This concept conceives of a centralized record maintenance function that could combine the record keeping and material handling operations of primary and secondary distribution to a considerable extent. The concept foresees eventual extension to include centralized production steps of typographic composition of DOD reports. This concept was discussed in detail in Section D, paragraph 2.8.3, above. The concept could eventually have a major impact upon the entire publica-

tion and distribution process. Capturing the record in machine-readable form near the source of authorship, plus achievement of automatic machine formatting, appears feasible and significantly more economical and efficient than the present procedures. However, the impact of such a concept would be of such magnitude and breadth in scope that an investigational study would have to be conducted before steps toward implementation could realistically take place. The projected plans provide for such an investigational study.

3.4.15 Other possibilities for future attention

There are a number of other system service concepts that could be hypothesized as DDC services depending on the extent of changes in its role and missions in the future.

DDC should continually appraise the Government Printing Office (GPO) capability for computer-driven composition. There are presently available several pieces of less complicated and less expensive equipment to do DDC's typographic composition production jobs in the event that present GPO facilities become overloaded to a point of insufficient capability to meet DDC's requirements.

DDC should continually appraise its system capabilities with respect to service concepts related to R&D program fiscal data services and other management information services that DDC might be asked to undertake.

DDC should further examine and investigate the feasibility of transmitting document requests plus bibliographic requests and high priority responses via telecommunications media. Many present Government telecommunications systems are in existence that could partially satisfy some of the priority DDC service demands especially in areas of management information services.

4. PROCESS ACTIVITIES, D&I ITEMS, AND CANDIDATE APPLICATIONS FOR MICROGRAPHIC MEDIA FOR PROVIDING SERVICES

4.1 Introduction

The string of process activities necessary to deliver an information service from source to user usually threads through three communities:

(a) Source Production (I) - In the case of technical reports this includes, for example, Government laboratories and contractor facilities engaged in research and development that generate reports on results of their work.

(b) Intermediate Processing (II) - Best typified by DDC itself, where original information, though produced in part at DDC, is primarily received from others (Community I) for the purpose of repackaging and processing for services styled to meet user needs.

(c) User Organizations/Individuals (III) - Where the information products and services available from both Source Production (I) and Intermediate Processing (II) Communities are delivered for use.

It is important that DDC maintain an awareness of the processing activities that occur in handling D&I items before they arrive as input to DDC, and to be aware of the activity patterns descriptive of the user community as they handle products and services provided by DDC. As evolutionary changes occur in assignments and missions of organizations participating in RDT&E STINFO service systems, lines of demarcation between these three communities (see Figure D-10) shift. Changes in both policy and technology can be forecast even at this time that are likely to redistribute responsibility for the processing activities employed in primary and secondary distribution of technical reports. Therefore, the analysis which follows considers process activities encountered in all three communities in order that the five-year projected plan will not be limited to simply the list of process activities performed by DDC today.

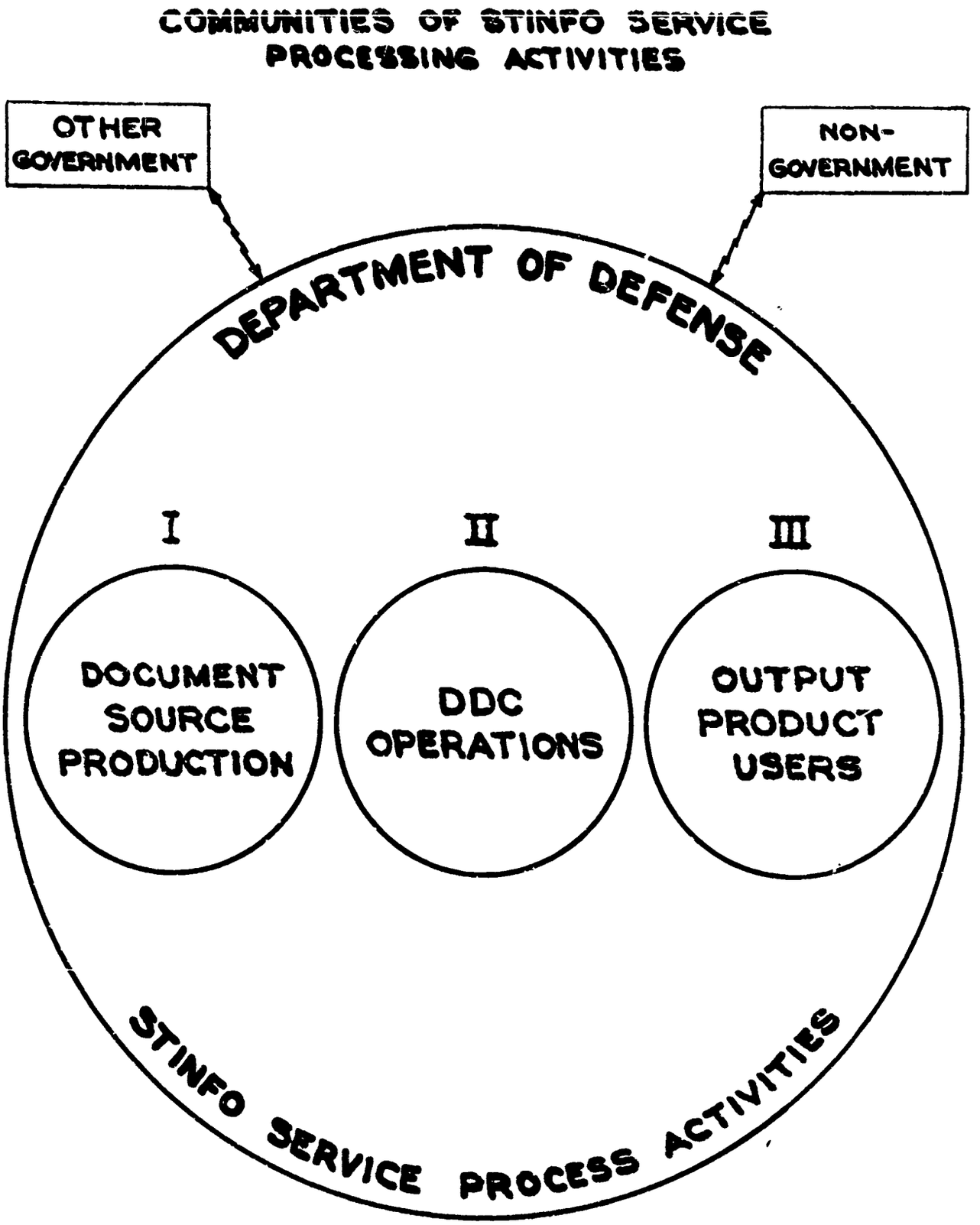

COMMUNITIES OF STINFO SERVICE
PROCESSING ACTIVITIES
OTHER GOVERNMENT
NON-GOVERNMENT
DEPARTMENT OF DEFENSE
I
II
III
DOCUMENT SOURCE PRODUCTION
DDC OPERATIONS
OUTPUT PRODUCT USERS
STINFO SERVICE PROCESS ACTIVITIES

Figure D-10

4.2 D&I Items and Process Activities Constituent to Service Concepts

The service concepts considered in Section D. 3 have been described in terms of their information content and format as delivered to the users. The service concepts are specific in nature and permit identification of physical D&I items (source, intermediate and end product) or communication media required. Thus for any specific service concept the set of D&I items necessary to provide the service can be listed.

In Figures 11 and 12 the D&I items necessary to provide existing service concepts A through O and projected new services N-1 through N-14 are displayed as column headings. Each row in this matrix identifies a specific process activity. Each column is subdivided to indicate those communities in which process steps are carried out in handling the D&I items.

This matrix readily shows "where the action is" throughout the entire region of overall STINFO service system activities and provides a first step for focusing attention to areas of special interest. It is also possible to adjust focus to other areas while at the same time maintaining an embracive picture of the "consequences" of selecting any particular service concept for implementation anywhere in the RDT&E STINFO service system network.

4.3 Identifying Areas of Application for Micrographics

Having chosen service concepts, and having identified constituent D&I items and the process activity steps through which they flow, the question can be asked at each point of entry on the matrix of Figures 11 and 12.

> "Is the handling of this D&I item at this process activity step a potential application for the use of micrographic record media?" (Note that this is not the same as asking if micrographic media would be a satisfactory substitute for the existing D&I record media. The area of interest is in whether or not there is an application of micrographic media in performing the process activity on the D&I item received as input.

It can also be asked if the process activity is an application for hard-copy and/or electronic data processing record media.

| | | |

[illegible]

Computer printout sheets	Magnetic tapes	Computer printout sheets	Original 1498 forms	4 x 6 microfiche masters	4 x 6 microfiche duplicates	Search tape masters	Duplicate magnetic search tapes	Technical reports as received and stored in warehouse inventory	Technical report copy as reproduced by DDC full size copy unit	4 x 6 inch microfiche (masters)	16mm roll film (masters)	35mm roll film "masters"	4 x 6 microfiche masters	4 x 6 microfiche carry away duplicates	page by page hard-copy printout from reader-printer	TAB	Computer listings of user register	Field of interest and security forms	Computer printouts	Camera ready copy	Contractor performance evaluation Form 1498	Contract and grant reduction reports	Form [illegible] Translations [illegible] for reference	[illegible] thesaurus [illegible]
i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii	i ii iii
x		x	x			x		x										x	x	x	x	x	x	x
	x		x					x										x	–	x	x	x	x	x
		x	x			x		x										x	x	x	x	x	x	x
								x	x															
								x	x															
		x			x			x	x	x	x								x	x				
		x						x	x	x					x									
		x						x	x															
		x						x	x						x									
	x				x	x	x x	x	x	x	x	x	x		x									
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x					x		x	x x	x			x	x											
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			x	x	x x			x	x	x	x	x	x	x	x			x						
x		x x	x	x	x x	x	x	x x	x x	x	x	x	x	x	x			x	x	x	x	x		
			x					x x	x	x	x			x				x						
		x						x										x	x	x	x		x	x
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					x			x x	x									x	x	x	x	x		
				x	x x	x	x				x	x	x	x				x						
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x			x	x	x	x
			x	x	x	x	x	x x	x x	x	x	x	x	x	x			x			x	x		
		x			x x			x x	x	x	x			x x	x			x	x	x				
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		x			x		x	x x	x										x					
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					x							x	x	x										
x		x			x			x	x			x	x	x	x						x	x		
					x							x	x	x										
x		x			x			x	x					x	x									
					x		x					x x	x x	x										
					x		x					x x	x x	x										
					x									x										
					x							x x	x x	x		x	x							

B

[illegible]	X		X	X	X	X	X	X		X		X						X		X	
[illegible]		X			X		X			X		X						X		X	
Unpack		X			X		X			X		X			X			X	X	X	
[illegible]	X	X	X	X	X	X	X	X	X	X	X	X			X		X		X		
[illegible]			X	X	X X	X	X X		X	X X	X	X			X		X		X	X	
[illegible]		X X	X	X	X X	X	X X	X	X	X X	X	X			X		X		X	X	
Compare		X X		X		X															X
[illegible] film photo								X					X			X				X	X
Transport		X X		X	X X	X	X X		X	X X	X	X	X		X	X	X	X	X	X	
[illegible]								X	X	X X	X	X X									
[illegible] merge			X														X				
[illegible]		X X	X	X	X X	X	X X			X X	X	X X					X				
[illegible]	X	X	X	X	X	X	X			X	X	X		X	X		X	X	X		
[illegible]	X	X		X	X	X	X			X	X	X			X		X	X	X		
Inspect	X	X		X	X	X	X	X	X	X	X	X	X			X	X	X			X
Edit	X					X			X		X		X			X	X				X
Chemical Process	X	X			X		X		X	X		X					X	X			
[illegible]	X	X									X		X			X	X				X
Format	X		X					X	X				X			X	X	X			X
Display	X	X X			X X		X X		X	X X		X X			X		X	X X	X	X	
Enlarge (view)	X	X X			X		X		X	X	X	X					X	X			
Roll roll duplicate	X																				
Fiche-fiche duplicate				X	X X	X	X X		X	X X	X	X X					X	X X			
Card card duplicate																					
Roll-fiche duplicate																					
Designate security	X	X	X		X X		X X		X	X X		X X									
Mailing		X			X		X		X	X		X						X			
Sub setting	X	X X	X	X	X X	X	X X	X	X	X X	X	X X	X		X	X	X	X	X		X
[illegible]		X			X		X			X		X	X			X		X			X
Labeling		X			X		X			X		X						X			
Stuffing		X			X	X	X			X	X	X X						X			
Acquisition	X	X		X	X X	X	X X		X	X X	X							X			
Blow back copy				X		X			X	X	X							X X			
Archiving	X									X											
Security downgrade		X X			X X		X X			X X		X X									
Scanning	X	X X	X	X	X X		X X		X	X X	X	X X		X							
Reading	X			X	X	X	X			X	X	X			X			X	X		
Browsing		X			X		X			X		X			X			X	X		
Carrying (personal)		X			X		X			X		X			X			X	X		
Viewing		X			X		X			X		X						X			
Reading for task use		X			X		X			X		X			X			X	X		
Blow back copy (few pages)		X			X		X			X		X						X			
Annotating contents		X			X		X			X		X			X			X	X		
Damaging	X	X			X		X			X		X						X			
Wearing	X	X			X		X			X		X						X			
Losing					X		X			X		X						X			
Rapid Retrieval		X			X		X			X		X						X			

A

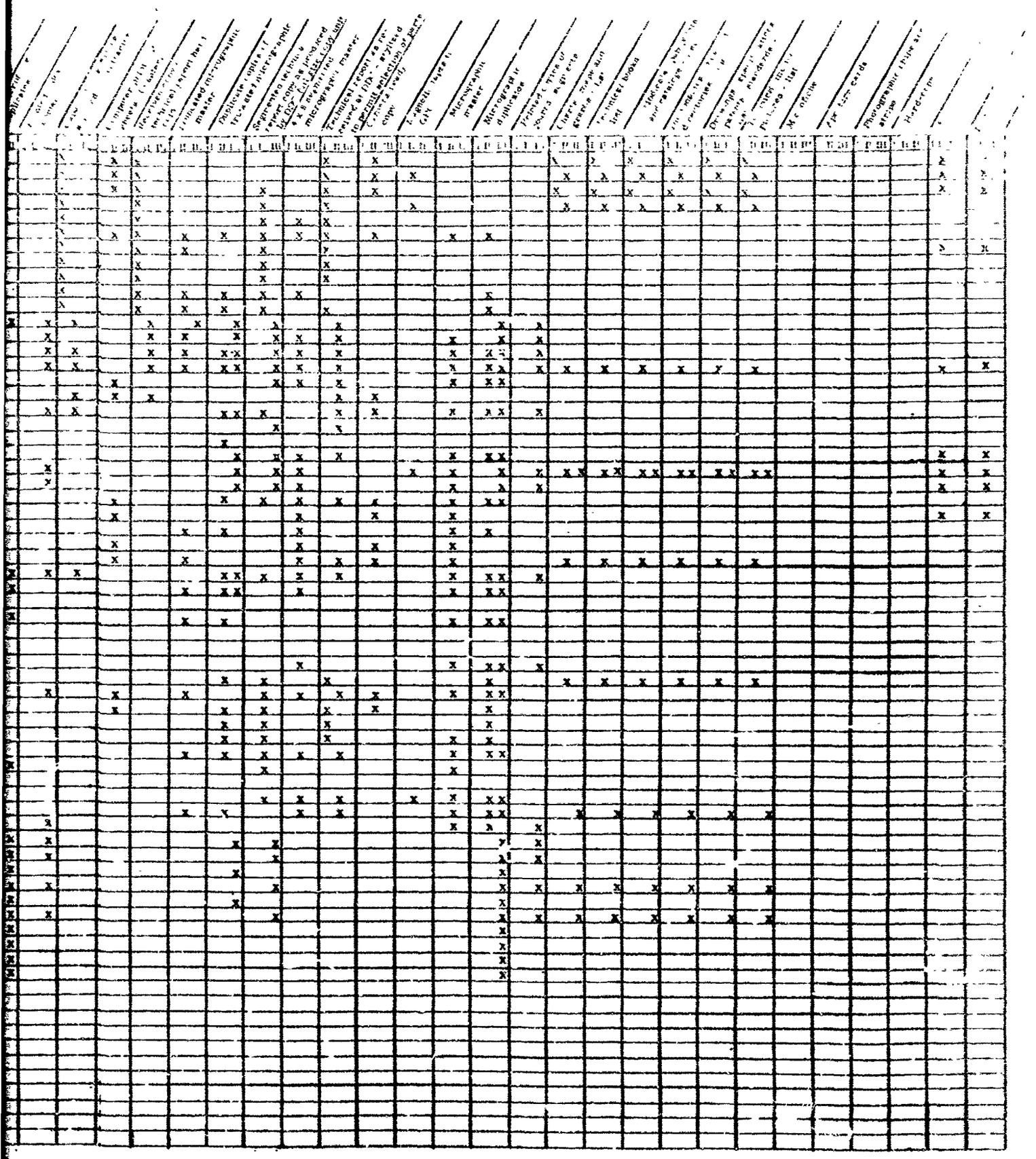
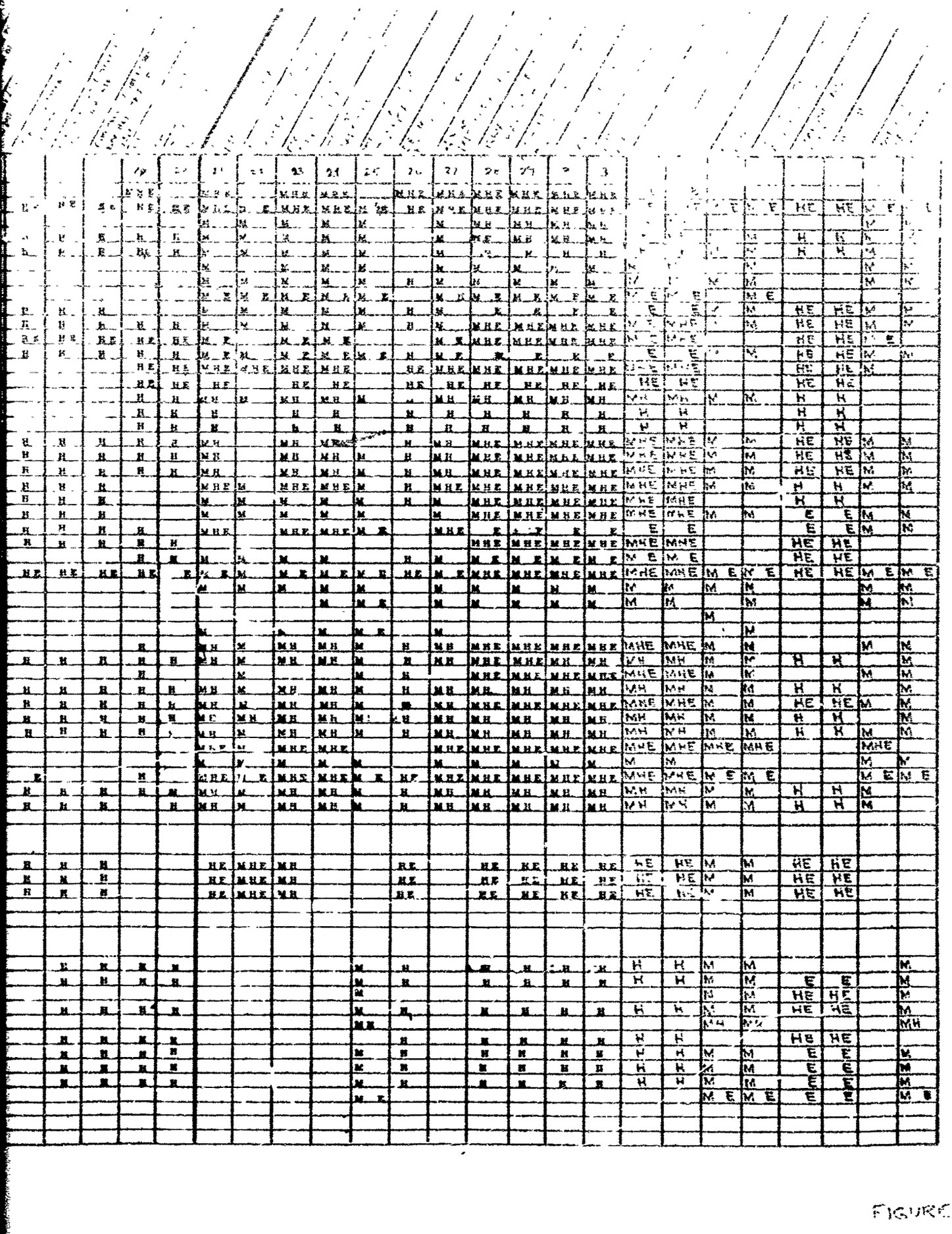

Duplicate copies of reports suitable for public release
Technical report series reviewed and approved for public release
Microprint master
Microprint duplicator
Microfilm - 16 mm
Microfilm - 35 mm
Microfiche
Photographic negative
Photographic positive
Hardcopy

FIGURE D-12 B

| | | |



B

FIGURE 0 13

In the matrix of Figure D-13 entries have been made to show the present or potential applications of three record media: (M) micrographics, (H) hard-copy, and (E) electronic data processing. The entries reflect both current practice and future methods that can be anticipated based on techniques under development. In the Figure D-13 matrix, the rows of process activity steps have been arrayed as follows:

(a) Community II Line - All process steps as may be found in community II (where intermediate processing is carried out).

(b) Community I - Those process activity steps unique to and found only in activities performed by the source production group. (Note that many of the process activities listed under Community II are also performed in Community I.)

(c) Community III - Those process activity steps which are found exclusively in the user community.

4.4 Technology Required to Implement Service Concepts

Using the matrix displays as tools for analysis, the individual process steps that present possible applications for micrographic media can be identified with sufficient specificity to clarify the particular demands on equipment, materials and methods. Flow rates, production capacity, load factors, and questions of compatibility of format and standards must, of course, be taken into consideration in identifying the particular technology to be selected to perform the process step where micrographic media is involved. Once these performance requirements are specified, the capabilities of available technology can be compared and the need for any new technological development identified.

The matrix displays as used here are powerful analytic tools for identifying specific development actions required in a highly detailed way. It is first necessary, of course, to identify the particular service concepts to which the development actions are to respond. In the sections which follow, choices of preferred service concepts have been made and structured into a set of alternative plans suggested for DDC to pursue over the next five years. The particular matrices presented in Figures 11, 12 and 13 are those that were used to identify the specific technological requirements to implement these services and to identify

the specific development actions required to achieve the projected production capabilities necessary to handle all the desired service applications of micrographics.

Although it is conceptually possible to transform the contents of the state-of-the-art knowledge (Part III of this report) into a capability matrix to perform the comparison between capability and need, this was not considered practical within the time scale of this study. Instead, state-of-the-art technology was taken into consideration by less formal, though no less valid, methods by the study team reviewing together both the selected service concepts and the development actions necessary for inclusion in the five-year plan.

A matrix of the technology in micrographics could be established and used advantageously in conjunction with the analytical tools presented herein as a method for DDC's maintenance of a continuing evaluation of available technology related to the requirements of future DDC plans and programs.

5. THE RATIONALE FOR SYNTHESIS OF AN ACTION PLAN

The methodology to be described in this section and which will be applied in Section F rests upon the development of a set of functions which it is deemed desirable that DDC accomplish, and which are consistent with the requirements placed on DDC. These functions are reflected in the set of service concepts described in Section D. 3. In parallel with this, all necessary D&I items and necessary process steps to accomplish given service concepts are presented in matrix form in Section D. 4. In addition it has previously been determined whether micrographics, hard-copy, or digital is a useful medium for processing the D&I item at each process step, and whether the process step is considered a candidate for the application of micrographics.

The following paragraphs deal with the method of analyzing these several bodies of information and their synthesis into development action plans.

5.1 Detail of the Methodology

The set of service concepts described in D. 3 derive from an inference of the desirable functions that DDC might serve within the context of its mission requirements. They have yet to be evaluated critically to see whether they are either achievable or, if so, whether they are actually desirable objectives. Those service concepts which survive this analysis remain to be integrated into an action plan or a set of alternative action plans. The arguments on desirability and feasibility (in the general sense) are mostly heuristic; those on achievability must appeal to state-of-the-art considerations and to pinpointing specific copies for study or equipment and materials development. The integration of any or all of them into a plan involves deeper consideration of the necessary specific developments in terms of scheduling, costs, and interim impact on present operations. For these reasons the rationale will be described in just that order: the ranking and grouping of candidate service concepts according to desirability and general feasibility; specific developments necessary to the achievement of the service concepts; synthesis of alternative plans.

5.1.1 The ranking and grouping of service concepts

There are two major areas of mission responsibilities for DDC. These are support services for RDT&E management, and the provision of Technical Information Services in direct support of RDT&E

programs and projects. Thus the desirability of a specific service concept can be estimated by the "value" it should have to users in both types of activity. DDC has a third mission to conduct developmental studies in the information processing field. This, however, is construed to mean in specific applications areas of interest to DDC operational missions. DDC is not expected to conduct research or support research for its own sake. Thus the desirability of undertaking a new service concept is not increased because it would present interesting development problems; its desirability must arise through operational missions.

Each candidate service concept is ranked as being low, medium, or high in regard to its value to each of the two operational missions. At the same time the general feasibility of accomplishing such a service is similarly estimated. To synthesize this information, "low" is assigned a value 2, "medium" a 4, and "high" a 6. Intermediate values of 3 or 5 can occur if it is reasonable to say that the desirability rests somewhere between low and medium, or medium and high. Nothing is done numerically with the assignment to feasibility. The scores or values are now summed, giving a total between 4 and 12.

The set of service concepts is then grouped into subsets whose scores fall within specified ranges. The choice of range is purely a matter of judgement. For example, scores of seven and above were used to define the most desirable group in the analysis in Section F. This would mean that the service would be more than moderately desirable to at least one of the two communities of users. In view of the dissimilarities in types of information needed by the two users, it is not surprising that no service would be expected to score as high as 12, or even as high as 10.

The rationale here described calls for similar treatment of contemplated service concepts that fall within a particular range of scores, unless strong indications to the contrary arise from feasibility or other arguments.

5.1.2 Specific development actions necessary to the achievement of service concepts

There are two levels of consideration of development actions relating to the implementation of a given service concept. These levels have to do, first, with minimal development actions which would enable the implementation of a certain service concept and, second, with accomplishing the same purpose more effectively - at some future time -

as a consequence of additional development. Where possible it is desirable to keep these levels distinct, for this may have much to do with the programming of a set of development actions, and will certainly have a place in discussions of the impact of the plan on DDC operations.

The identification of detailed development requirements comes mainly from state-of-the-art considerations, as well as from knowledge of the present capabilities (production-wise as well as technological) of DDC. The vehicle used in establishing the particular developments necessary to a specific service concept is the matrix of D&I items versus process steps previously developed for each service concept (see Figures 11 and 12), and that matrix which identifies possible areas of application of micrographic media (Figure 13).

All aspects of development requirements have to be considered here. These will include materials, equipment, methods, and procedures. Also to be considered are feasibility studies and pilot operations. All the relevant development actions are then evaluated for cost in dollars, manpower, and time.

5.1.3 If a specific purpose is to look particularly for applications of a special form, process, or method, the examination of the admissibility with regard to that form or process should be made with care. In the present instance, for example, interest is focussed on possible applications of micrographic forms within the sequence of process steps that result in a service, as well as its consideration as a form for the final product. The mere possibility of making a certain D&I item in a special form is not a sufficient reason for so doing. One must consider the sequence of process steps that together comprise the service concept, and systematically study the impact of the introduction of a new form at any step. Further, the relations with other service concepts which may well involve the same process steps must be examined.

Once the specific development actions are specified they must be evaluated as to cost, in both dollars and manpower, and time. If there is a natural sequencing to the set of development actions relating to a service concept, this too must be specified, for it must be known where the undertaking of some particular development step depends on having completed some other. This then yields, for a given service concept, a string of development actions that is similar to a PERT chart in that it shows some sequencing and parallelism in the required actions. These may be placed along a time line where the "step completion events" are separated by at least the minimum times required for each development.

With two or more such displays relating to the service concepts that comprise the action plan under consideration, a composite chart can be prepared showing all the development steps relating to the complete plan. In some cases the same development step may be found in more than one service concept sequence. If so, the development requirements for the two merge, but there is now an interaction between the two that affects the scheduling.

The further scheduling involves the consideration of resources, money and manpower, and their effect on the time it will take to achieve a given development step. Some allocation of resources has to be made on the basis of other considerations, once such alternatives appear.

The final arguments that are brought to bear on the plan relate to some considerations that are less technical than those just described. The two main types of these are policy considerations and training. It may be that implementation of a plan, or implementation of a service resulting from the indicated development, requires changes in policy at levels higher than DDC. Time may be consumed in effecting the change or, indeed, it may turn out to be denied. Such a contingency should be taken into account before DDC launches a long-range development action plan. Training has two aspects: (1) training personnel in DDC to carry out new processes or procedures, and (2) educating users to the desirability of receiving new and different products, or having available new information services.

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E. APPRAISAL OF PROJECTED UTILITY AND FEASIBILITY OF MICROGRAPHIC MEDIA IN DDC OPERATIONS

NOTE:

This section, still in preparation, will equate document handling service systems to activities heavily involved with material handling. The argument will proceed pointing out that the prime utility of micrographic record media is in the reduction of material handling problems insofar as bulk shipment and storage are concerned. Recognition will be given to the special problems created in material handling by use of micrographics.

The characteristics and attributes of various micrographic media, such as video tape, photographic films--including silver emulsion, diazo and Kalvar--will be briefly described; also to be mentioned are plastic thermo-recording media and the direct imprint letter press method used to prepare Microprint (opaque) cards. The prime areas for application of various formats including cartridge roll film, aperture cards, microfiche, etc. will be identified.

As a result of the findings in the State-of-the-Art Review, we will summarize the activity levels now estimated in production, use, and R&D in the major micrographics areas. This will show a very sharp comparative increase in the utilization of microfiche and cartridge roll film.

The section will end describing the selection of the COSATI standard microfiche format for unit records handling such items as technical reports. It will recommend supplementing this with the use of cartridge roll film in information products as typified by the suggested annual cumulations of TAB abstracts and indexes.

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F. FIVE-YEAR DDC DEVELOPMENT ACTION PLANS

1. INTRODUCTION

There are two main areas of concern that relate to the development program of DDC. The first of these relates to the overall system philosophy which should guide DDC in all of its development activities -- Integrated Process Control. The point which will be made is that any evolution should be consistent with the fundamental purpose of shifting from "batch processing" to a more "continuous processing" mode of operation. The second area deals with a systematic development of action plans, the methodology for which is described in Section D. 6. These plans are composed of more or less desirable service concepts which are analyzed to determine the development actions which they imply and the costs that will be incurred if they are selected.

In this section a set of alternative action plans will be developed with evaluative information included for each plan to assist in making a decision on which of them to pursue. It should be pointed out that the choice of plans and the manner of their implementation should be such as to lend itself to the integrated system philosophy, although the conversion of present operations to a continuous mode of operation is not described as a development action.

One further remark is necessary: throughout all development planning and implementation, DDC should maintain a careful watch over industrial developments that may be applicable to DDC operations and maintain a budgeted line item for the test and evaluation of such new equipment.

2. SYSTEM PHILOSOPHY - INTEGRATED PROCESS CONTROL

The conceptual design of an optimal system to be considered by DDC should reflect an understanding of the problems involved in the production environment. In any serial process, the system as a whole becomes dependent upon and subordinate to the constraints imposed by the slowest operation in the system. If the system is designed such that slowdowns and stoppages in one process propagate their effects down the line, the entire system will slowly but inexorably reflect this slowdown or stoppage. However, if it is possible to propagate information about a problem ahead of its effects, then resources may be reallocated from other elements of the system to alleviate the difficulty in the shortest possible time. This is the area of management information and controls.

No matter what method is chosen to overcome such difficulties in a conventional system, problems still arise. If management depends upon notification from line-supervisors regarding a trouble area, then the problem solution is critically dependent upon cooperation by individuals who may themselves be personally involved. If the situation were to be deduced from analysis of numerical data representing flow rates through various parts of the system, an excessive amount of manpower would have to be expended in accumulating and recording such data.

The advent of the modern high-speed digital computer promises a very real solution to this problem. If the computer is properly and fully integrated into the production apparatus, the accumulation of data and production/flow statistics becomes merely a matter of an extra few seconds or so on the part of an operator in each step of the process. These statistics may be accumulated over any desired period, and reports can be automatically generated for any level of management to reflect the status of the system at any given moment in time.

Thus it is necessary that the digital computer be an on-line real-time device, monitoring and, in a sense, pacing the production process itself, rather than merely being utilized as a "batch" tool for solution of engineering problems and document retrieval. Design of the system, starting from primary considerations, must take into account the presence and interactive nature of the computer in the production process.

The benefits arising from operations integrated around the digital computer are obviously not limited to those which accrue to management via such information systems. It is anticipated that there will be savings and improvements realized in the areas of costs, productivity, and turn-around time.

Costs will be lowered due to the integrated system's potential of doing the same job as a manual or non-integrated system, but with fewer personnel. The application of the computer to many of the record-keeping, data collection, and other "housekeeping" chores will free (or eliminate the need for) a portion of the total personnel resources, and allow them to be allocated elsewhere as the situation requires. Many forms and other paper documents will be replaced by direct data acquisition at the level of computer-controlled magnetic recording media. These devices, such as tapes, disks, and drums, offer non-destructive recording and 100 percent reusability.

Improvements in productivity will be realized because of the improved interface, made possible by the digital computer, between a given task and the data which characterizes it. Manual search, retrieval, and inquiry will be virtually eliminated by the maintenance of all pertinent data files on rapid-access magnetic storage media, whereon the computer will be able to perform all desired searches based on a set of simple human-directed instructions. Of course, the computer's inherent speed and freedom from human error should not be overlooked.

Reduction in turn-around time (or throughput time) will be realized basically as a result of improved productivity, but will be maintained even in the face of vastly increased production volume. Conventional production lines tend to bog down when production demands rise far in excess of some average or norm. A machine-paced system, however, will be able to accommodate wide ranges of demand on the production apparatus without becoming "confused" as a result of the stepped-up operations.

A convenient means of illustrating the principal departures of this system organization from that which is currently used is to depict the progress of a typical incoming technical report as it flows through the various stages of the system under each of the two philosophies. It will be informative during the description which follows to refer to the flow diagrams in Figures F-1 and F-2 which show the major functional activities of both systems in block form.

The major distinguishable functions which must be performed on every incoming document are seen to be receipt, check for duplication, check for acceptability, abstracting and indexing, microfiche preparation, and storage. (Although DDC resources may not be allocated in such a way as to emphasize this particular division of effort, nevertheless these are the principal, logically independent and non-overlapping steps which must be performed on every document.)

In Figure F-1, the serial nature of the process is evident from the layout of the tasks to be performed on the incoming document. In the present method, the computer is used only as an input medium for the citations, abstracts, and descriptor terms which are extracted from documents during their flow through the system. The computer file thus generated is used for the preparation of TAB and for retrieval of documents in the request cycle. The physical flow of materials from one step to the next is accomplished mainly by transporting them on

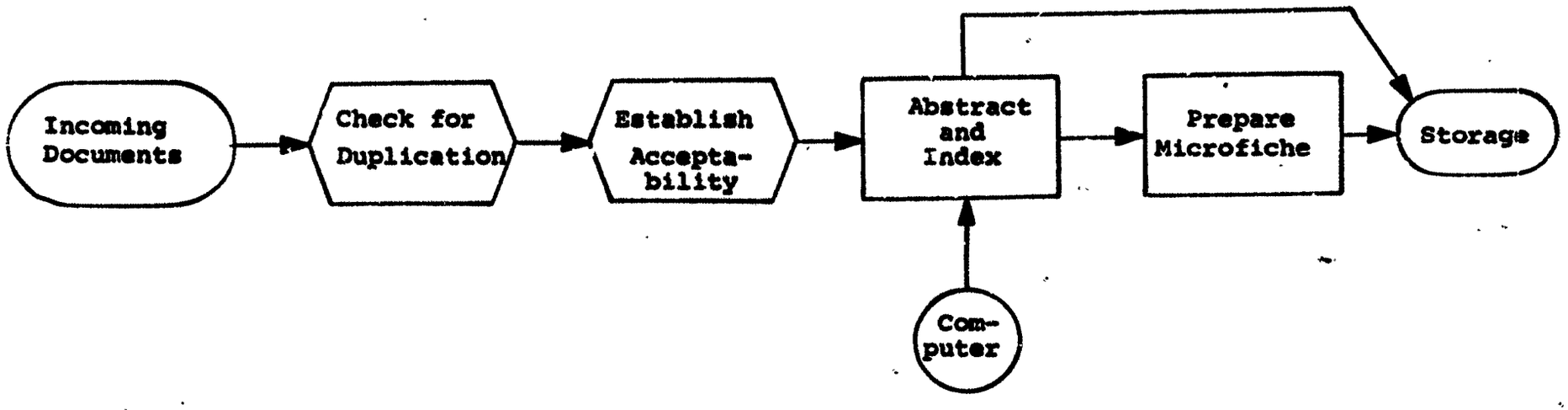

Figure F1.
Serial Batch Processing of Incoming Reports

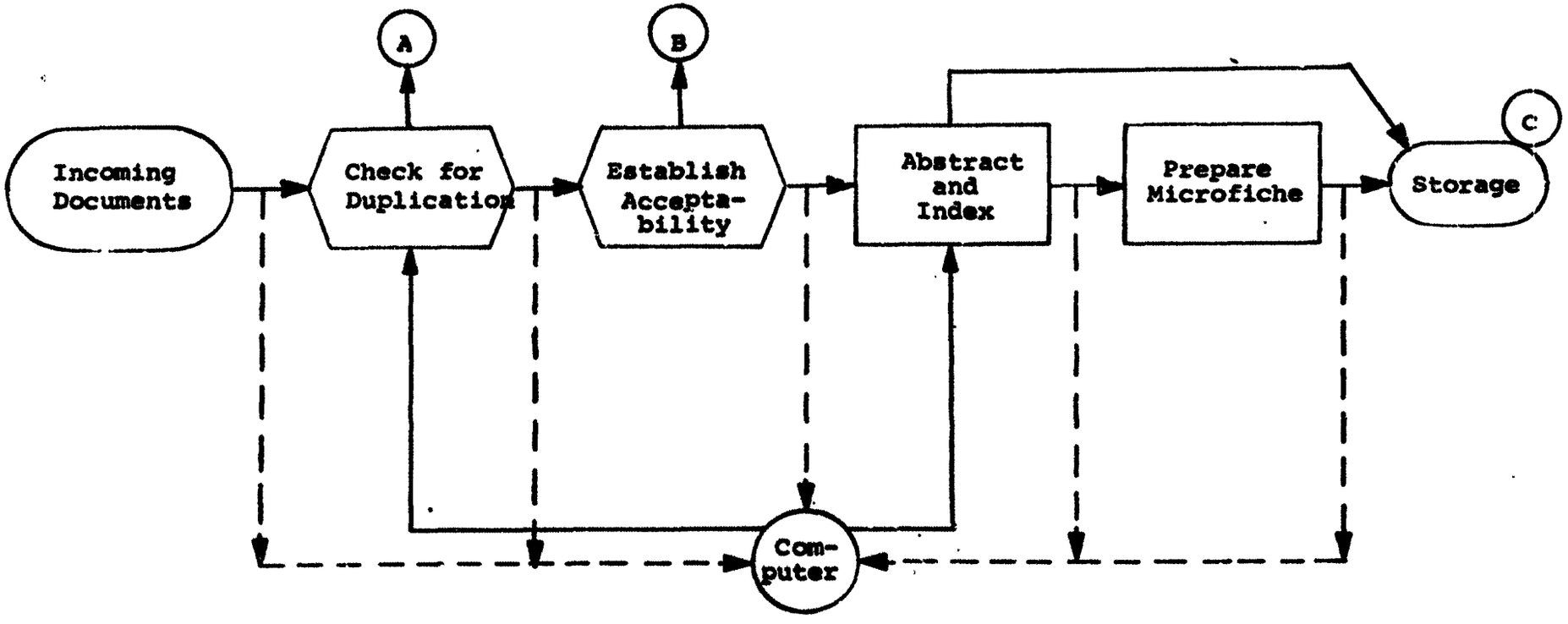

Figure F2.
Continuous-Flow Processing with Computer Control

mail carts or the equivalent. Documents are generally "batched" at the end of each operation where they wait until a mail cart is "reasonably full", whereupon they are transported to the next station. Thus the flow rate of documents through the system is not a function of overall policy. It is rather a function of the size of the mail carts, and even of the judgment of the cart operators.

Every document is logged in and out of each processing station; therefore, if enough records are searched, it is possible to locate by number any given document in the system. However, it is not clear what managerial information this locating ability provides. The truly relevant information about the operation is the flow of materials from station to station through the system, rather than the progress of any single document. In fact, under this "batch" method, it is possible for documents to be processed through a given station on a last-in-first-out basis, which implies that while a given document may be routed through the system in the shortest possible time, another may wait at the bottom of a stack until a lull in operation permits the station operator to completely eliminate the backlog of documents at his station and finally reach the bottom of the stack. Uneven flows throughout the system are not detected by keeping records on individual documents; therefore, the overall throughput of the system can never be accurately determined except at the initial input and final output steps.

Reference is now made to Figure F-2, the integrated plant control system. In this system design, each document is logged in by its unique number in the initial input stage, but is not followed through the system in a step-by-step manner. It is known that every incoming document must exit from the system in one of three ways: it may be a duplicate document (exit A); it may be deemed unacceptable by DDC (exit B); or it may be processed through the entire system and finally reside in document storage (exit C).

If the three possible exits are monitored for all documents flowing out through them, then these lists may be checked against the list of incoming documents to ensure that none have been lost within the system. Except for problems which arise as a result of security classifications, no other individual document history need be kept during the production process. Instead, a series of counters or other digital recording devices are placed at the output area of each station. As processing is completed on each document, the operator increments the digital counter and places the document in the output area of his station. At given intervals of time, the contents of the counters

throughout the system are recorded and entered into the computer in machine-readable form (punched cards or typewriter console). The computer is then able to generate reports showing overall system flows, output rates at every station, and backlog situations which may have developed during the past data-collection period. In addition to these day-by-day reports, the computer may also be instructed to prepare reports over longer periods of time which may be used by higher-level DDC management to detect long term trends in document ordering rates, production efficiency, etc. It is easy to visualize the computer taking over certain other routine functions as well. For example, the rate of document flow through the system may enable the computer to order supplies and equipment automatically, such as film, tab cards, and file cabinets. Many such functions can be performed automatically at the discretion of management, so long as the computer automatically obtains basic information on document flow.

It is also absolutely essential that every operator process incoming documents on a first-in-first-out basis, so that no documents are permitted to accumulate at the bottom of input stacks as in the present arrangement. Obviously some exceptions may be made to this rule in the way of priority orders, etc., but in general the flow must be completely serial with respect to documents as well as to processing.

At this point, a word is in order concerning the procurement of the computers to be used as the basis of the integrated production system. It is highly desirable that the latest third-generation computers be chosen for this task because they alone can accommodate the wide varieties of input/output hardware which are necessary to interact directly with the production process. Several "families" of third-generation equipment are offered by the major computer manufacturers, notably IBM, RCA, and UNIVAC. If a machine is chosen which is program-compatible with larger machines in the same series, then conversion to a larger computer (to reflect stepped-up production requirements) would require only a minor break in operations. (Complete reprogramming of the computer system should be avoided if at all possible.) Most of the man/machine interfacing should take place at the level of the typewriter console (such as IBM model 1050, 1052 or equivalent). The typewriter has been demonstrated to be the input/output device most suitable to a wide range of skilled and/or unskilled human operators, providing reasonably fast communication and relatively high reliability at very reasonable cost.

An idea which should be explored is that of acquiring several smaller identical computers with interchangeable bulk memory devices (such as disk-packs), rather than one very large computer. If the entire shop operation depends upon the assistance of a single computer, then whenever this computer is disabled or otherwise unavailable, the entire process will slow down or stop. In such a case, multiple computers which have the capacity to exchange programs directly will be of great assistance, since the unavailability of any one of them will not preclude the possibility of having its programs run on one of the others. If the bulk memory devices were also interchangeable, its files and other information could be brought along as well. The economics of such an approach should be explored in depth before any procurement is considered.

The degree of upheaval and discontinuity of operations resulting from a transition to such a system as the one just described may be minimized by careful planning. Obviously, if the new system is installed from the bottom up in one huge swapping operation, great difficulty will result during the physical installation of new equipment and also during the period of system debugging and personnel training. On the other hand, the results should be manageable if one logical phase of the system were installed at a time and phased slowly into existing operations. Many organizations have successfully performed such a transition. However, it should not be overlooked that sizable investments in hardware, programs, and personnel retraining will be required before an integrated system is fully functional and in production.

3. THE SYNTHESIS OF ACTION PLANS

3.1 Assumptions

3.1.1 Introduction

It is difficult to enunciate an entirely consistent development action plan in the absence of clearly stated objectives. However, since DDC is involved in a support function, insofar as DOD operational missions are concerned, it is possible to infer a set of requirements that are at least consistent to the extent that, once they are met, DDC is in a position to provide better overall access to information in a more timely way, and in forms better adapted to processing, storing, and utilization. Care should be taken, however, not to interpret these requirements as true objectives, for it may lead to doubtful conclusions: that if a little information is good, more is better,

even without limit; that everyone should have access to all information; and that success in an operational mission can be assured through increasing the quantity of support. For it is probably true of information support, as it is with logistical support (for example) in a military operation, that the marginal payoff as quantity of support is increased tends to diminish; and further may even become negative as the burden of the support operations becomes excessive.

3.1.2 Review of Requirements and Missions

The details of DDC mission elements have been presented in Section B.2, and requirements have been developed in Section B. 3.5. The latter derive from a set of assumptions as to the nature of the overall information system picture as it might evolve over the next five years, and the position of DDC within that picture. In order to deduce candidate service concepts, further assumptions are required regarding the outside forces acting on DDC, the feasibility of implementation of the services, and their expected payoff. These assumptions are:

(a) Additional services contemplated for DDC must lie within the scope of the two major missions: management information systems and technical information services.

(b) Drastic changes in policy that must be established external to DDC are considered sufficient reason to exclude service concepts which demand such changes.

(c) Service concepts which have a multiple impact are considered the more acceptable.

(d) Concepts are favored that derive from existing process capabilities, and which offer distinctly advantageous consequences to the user.

(e) Concepts that depend, for their implementation, on a breakthrough in state-of-the-art in materials or machinery are not considered feasible within the five-year period of the plan.

(f) Service concepts which require extensive preliminary feasibility studies are to be considered of marginal interest to the action plan, unless tremendous benefits are obvious.

(g) If the payoff of a service is low, it is of marginal interest even though it may be easily implemented.

3.2 Evaluating the Desirability and Feasibility of Service Concepts

3.2.1 Ranking the service concepts

The candidate list of service concepts has been described in Section D. 3. There are 14 of these "new" services which are contemplated. As explained in the methodology description in Section D. 5, these will be ranked or scored depending on whether they seem to be low, medium, or high in their impact on each of the two operational mission areas of DDC: Management Information Systems Support (MISS), and Technical Information Service Support (TISS). Further, the overall feasibility is estimated in the same terms, although no numerical scoring is attached. The service concepts are numbered N 1 through N 14, and each is also labeled as requiring exploratory development or advanced development for its realization. Table F-1 presents these evaluations. The ranking here -- that is, the selection of scores -- is seen to be quite arbitrary. There is no real means of making quantitative assessments, and much rests on the judgment of the value of the service to the customer community.

TABLE F-1

RANKING THE SERVICE CONCEPTS

Service Concept Number	Title	Desirability: MISS	Score	TISS	Score	Total Score	Feasibility	Type of Development
N1	TAB on Microfilm	low	2	med/high	5	7	med	advanced
N2	State-of-the-Art Packages	low	2	med	4	6	high	advanced
N3	Task-oriented Sets	low	2	med/high	5	7	high	advanced
N4	Source Production Microfiche	low	2	low	2	4	low/med	advanced
N5	RFP Packages	high	6	med	4	10	high	advanced
N6	Research-in Progress Indexes	high	6	med	4	10	high	advanced
N7	Contractor Capabilities	med	4	med	4	8	high	advanced
N8	Automated CPE/CCR	med	4	low	2	6	high	advanced
N9	Truncated Announcements	low	2	med	4	6	med	exploratory
N10	Segmented Announcement Journals	low	2	low	2	4	low	exploratory
N11	Segmented TAB	low	2	low	2	4	med	advanced
N12	Bibliographic Non-report Materials	med	4	high	6	10	low	exploratory
N13	Distribution of Non-report Materials	low	2	high	6	8	low	exploratory
N14	Merging of Primary and Secondary Distribution	low	2	med	4	6	med/high	exploratory

3.2.2 Grouping the service concepts

The service concepts are now separated, making use of the scores developed in the preceding section, into groups which might be described as a sort of priority classification. This grouping is shown in Table F - 2.

3.3 Specific Development Actions to Achieve Candidate Service Concepts

Each of the service concepts has been traced through independently of all others, in order to identify the development actions necessary to its achievement. Although some overlap is seen, when the same development is required for more than one concept, they are kept separated so that the implementation of any specific service concept can be considered apart from the others. In the brief paragraph discussions that follow, the concepts themselves are not fully described, for this has been done in Section D. 3; the commentary here is confined just to development activities, with only enough of the concept described to justify a decision as to what must be done. Each paragraph closes with a listing of the actions.

3.3.1 Concept N 1, distribution of TAB and Indexes on microfilm

This concept envisages the publication of cumulative announcement journals and indexes on microfilm, and as such involves a direct digital-to-microfilm conversion capability, such as could be had by using the Stromberg-Carlson SC 4020 equipment.

Developments Required:

N 1-1 (Equipment) Rental of SC ~~4020~~ 4400.

N 1 - 2 (Equipment) Modification of the Itek Platemaster to accommodate 16 mm roll film is necessary.

N 1 - 3 (Equipment) Modify the Tecnifax H 1 R Diazo-Microfilm Processor for automatic insertion of film into cartridges.

N 1 - 4 (Equipment) Modification of the 3 M Filmar Reader/Printer for microfiche.

Table F-2. CLASSIFICATION OF SERVICE CONCEPTS

Group (or priority)	Service Concepts	Desirability Score	Feasibility
A	N 5	(10)	high
	N 6		high
	N 12*		low
B	N 7	(7-8)	high
	N 3		high
	N 1		medium
	N 13*		low
C	N 2	(6)	high
	N 8		high
	N 9		medium
	N 14*		medium/high
D	N 11	(4)	medium
	N 4		low/medium
	N 10*		low

*Development considered mainly of exploratory type.

N 1 - 5 (Method) Two computer programs are needed for conversion and formatting of the master tape files for TAB and the Indexes.

N 1 - 6 (Method) Methods of roll film cartridge labeling should be developed.

Notes:

(a) It is estimated that there would be about 500 users of this type of product in the first year of its introduction, growing to about 1000 by the end of five years.

(b) The initial year's business would amount to about 2500 roll microfilm cartridges, each containing the equivalent of about 2000 pages.

(c) DDC should keep watch of digital-to-microfilm conversion equipment developments, with special attention to higher quality composition, with less distortion than that now available.

3.3.2 Concept N 2. State-of-the-art packages

This concept envisages the on-demand distribution of full-text reports on microfilm, collated into current state-of-the-art reviews. This service could, in principle, start immediately. However, there are intellectual problems that must be solved eventually which deal with how reports can be selected which truly represent the most up-to-date picture of the state-of-the-art, and also how to purge the package of materials which are out of date.

Developments Required:

N 2-1 (Equipment) Development of a double-knife chopper so that microfiche may be prepared that are of uniform size.

N 2-2 (Equipment) Maintenance of the intermediate master (105 mm roll film) of subject sets implies purging and updating, which in turn mean cutting and removing certain frames and inserting new ones. Although tape splicing can be done satisfactorily, it would be desirable to have equipment for thermal butt-splicing the film.

N 2-3 (Method) Maintenance of the intermediate master requires special attention. The concept is being considered in terms of preparing the intermediate master by a microfiche-to-roll transfer, from which duplicates can be prepared for distribution. These sets must be purged of old material, and new must occasionally be added. There are problems of wear and destruction due to repeated cutting and splicing which must be solved.

N 2-4 (Method) A computer program for maintenance of the indexes of contents of the subject sets must be developed.

N 2-5 (Method) A computer program for maintenance of distribution files must be developed.

N 2-6 (Method) Methods have to be developed for grouping, sorting, stuffing, and packaging the microfiche.

N 2-7 (Procedure) Develop procedure for maintaining two "levels" in the subject-set packages according to "unclassified" and "classified and unclassified" documents included.

N 2-8 (Study) A study "Maintaining Currency in State-of-the-Art Subject Sets" should be conducted. It is possible to perform this service now, but it requires using highly trained scientific personnel. More standardized methods need to be developed for doing this, requiring a model based on well defined "indicators" which will permit purging and updating without reliance on subject-specialized personnel.

3.3.3 Concept N 3. Task-oriented sets

This concept envisages the distribution of sets of reports on microfiche, related to specific tasks which are involved in an R&D project.

Developments Required:

N 3-1 (Equipment) Double-knife chopper (described in paragraph 3.3.2, N 2-1)

N 3-2 (Method) Task pattern analysis methods must be developed which more specifically describe the fields of interest than can now be inferred from project descriptors.

N 3-3 (Method) Intermediate master maintenance. The problem is exactly that described in paragraph 3.3.2, N 2-3.

N 3-4 (Method) Computer routines are required for updating distributed files and user profiles.

N 3-5 (Method) Grouping, sorting, stuffing and packaging problems, such as described in paragraph 3.3.2, N 2-6, must be solved for this application also.

N 3-6 (Procedure) Procedures for handling the problem of inclusion of classified documents in the subject sets have to be developed. These are not necessarily the same as those for State-of-the-Art Reviews.

N 3-7 (Study) A study should be conducted which considers the redesign of the data elements on the 1498 form so that subject fields of relevance are better designed.

3.3.4 Concept N 4. Production of microfiche masters at the source location

This concept envisages the production of the microfiche master at the point of origin of the document, and transmission of the master to DDC.

Developments Required:

N 4-1 (Procedure) Procedures have to be prepared which contractors may follow at their own locations for producing microfiche which meet DDC standards of quality.

N 4-2 (Procedure) Procedures must be developed for assignment of AD numbers (perhaps by blocks) to the producer, and for duplicate checking on receipt by DDC.

3.3.5 Concept N 5. RFP packages

This concept envisages the preparation of special, one-time-only, sets of documents on microfiche for distribution to bidders on DOD procurements, as back-up data and information.

Developments Required:

N 5 - 1 (Equipment) Double-knife chopper, as described in paragraph 3.3.2, N 2 - 1.

N 5 - 2 (Method) Methods for grouping, sorting, stuffing, and packaging.

N 5 - 3 (Procedure) Problems of classification arise here similar to those for other services calling for specialized subject sets. Procedures have to be established to govern the composition of the packages and their handling by the bidders.

3.3.6 Concept N 6. Research-in-progress hard-copy indexes

This concept envisages the utilization of data on the 1498 form to prepare indexes for use by the DOD scientific and technical community to maintain awareness of work going on and where specialized knowledge may be found.

Developments Required:

N 6 - 1 (Method) Develop computer sorting and formatting routines to provide various types of look-up capability.

N 6 - 2 (Study) The problem of an effective, controlled vocabulary, which can be used on the 1498 and by users of the indexes, should be studied.

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3.3.7 Concept N7. Contractor capabilities listing and descriptive support information

This concept deals with a further aspect of management, in the procurement area, beyond that described in paragraph 3.3.6, N6. Contractors are to submit, to one office only (DDC), information on their capabilities and facilities and resume information. DDC maintains a Data Bank, similar to that of the 1498, and procurement offices submit requests for various kinds of "cuts" through this data to obtain specialized listings of companies according to technical capabilities, production capabilities, geographical locations, or other file variables. Procurement offices are furnished files on microfilm of companies that fall within defined categories, and these are selectively updated by DDC on a current basis.

Contractors or potential contractors prepare two kinds of input information. One is formatted data specified by DDC, the other is textual resume information. Resume information may be submitted in microfiche by the contractor with updating information furnished in the same way. Formatted data may be submitted by the contractor to DDC on a specified periodic basis, or on occasions when significant changes warrant updating.

Developments Required:

N 7 - 1 (Methods) Various computer file input, sort, analysis, collation, and output routines are needed.

N 7 - 2 (Procedures) Develop receipt and input processing.

N 7 - 3 (Procedure) Design contractor data input format.

N 7 - 4 (Procedure) Develop contractor data update procedures.

N 7 - 5 (Procedure) Develop file maintenance procedures for profiles of interest.

3.3.8 Concept N 8. Automated CPE/CCR files

This concept deals with DDC automating the CPE/CCR data files, and furnishing computer-generated reports.

Developments Required:

N 8 - 1 (Method) Establish ADP files and write, sort and format routines.

3.3.9 Concept N 9. Truncated technical reports in microform

This concept involves microfilming selected pages from a document so that the user may procure and read only a very small volume of material (but more than is available in an abstract) to enable him to determine whether he desires to receive the complete document.

Developments Required:

N 9 - 1 (Study) A basic study is needed to determine the real request motivations.

N 9 - 2 (Study) Identify and evaluate alternative approaches to truncation: that is, how much additional information beyond the abstract is needed for a user to determine that he does not want the whole document.

N 9 - 3 (Study) Once the requirements have been determined, a study should be made to evaluate methods of achieving such truncation.

3.3.10 Concept N 10. On-demand distribution of segmented technical reports in hard-copy

This concept envisages that reports could be formatted that a user could request only those portions that are of interest to him.

Developments Required:

N 10 - 1 (Study) This subject requires a careful feasibility study in advance of any plans for implementation. Undoubtedly, any requirement for an author to mold his report into a specific format would meet strong resistance from the technical community.

3.3.11 Concept N 11. Distribution of segmented announcement journals on microform and hard-copy

This concept suggests that announcement journals could be segmented by subject so that a single user need not obtain more categories than he needs or desires.

Developments Required:

N 11 - 1 (Study) The utility and demand for segmented announcement journals should be explored prior to contemplating a multiplicity of small announcements to replace a large one.

3.3.12 Concept N 12. Maintenance of bibliographic files of technical D&I items other than technical reports

This concept envisages maintenance of bibliographic information on all other forms of technical information, including technical books, drawings, photographs, and engineering data.

Developments Required:

N 12 - 1 (Study) An exploratory study is required to estimate the magnitude of the problems and tasks involved in maintaining such records.

3.3.13 Concept N 13. Distribution of technical materials other than technical reports

This concept extends that of N 12 to include the on-demand distribution of all varieties of scientific and technical information, including engineering data, books, and drawings.

Developments Required:

N 13 - 1 (Study) An exploratory development study is needed to assess the technical problems involved in accomplishing such distribution.

3.3.14 Concept N 14. Merging of primary and secondary distribution

This concept envisages the centralized record control and distribution of reports, and source data automation for technical report publication.

Developments Required:

N 14 - 1 (Study) Evaluate the impact of implementing research- in-progress indexing (Concept N 6) on secondary distribution traffic pattern.

N 14 - 2 (Study) Evaluate merits of centralized record keeping in controlling primary distribution.

N 14 - 3 (Study) Determine feasibility of source data automation in technical report publication.

3.4 In-House Manpower and Dollar Cost Estimates

Development actions identified for each of the service concepts were considered from the point of view of costs in both money and in-house manpower. These estimates are summarized in Table F-3.

3.5 Forming Plan Sets

The discussion in paragraph 3.2.2 resulted in breaking down the set of fourteen candidate service concepts into four groups, A through D, in order of decreasing desirability and general feasibility. Many of those numbered N 9 to N 14 turned out to be either low in general desirability or in feasibility, and were indicated as depending mainly on exploratory studies.

The alternatives, as to development action plans, are easily formulated. Plan Zero is considered to consist only of the present set of services that DDC offers. Development actions are nevertheless needed in order that the present services can continue under increased traffic volumes. Alternative development action plan sets will contain Plan Zero together with added service concepts contained in Group A, then adding Group B, and so on. The alternative action plans then contain:

Plan Zero	Present Services
Plan 1	Zero plus Group A N 5, 6, 12
Plan 2	Plan 1 plus Group B
Plan 3	Plan 2 plus Group C
Plan 4	Plan 3 plus Group D

3.6 Plan Zero

3.6.1 Introduction

The following sections deal with projected workloads, indicated development actions, developments relating to integrated process control, and a summary of Plan.

3.6.2 Projected loads

The following analysis of projected loads is based upon historical data, on-site experiences and analysis of the logical and proper directions in which the various activities are expected to go. The projection analyses are discussed in five parts:

(a) Requirements for reports and bibliographies

(b) Copy request fulfillment

(c) Selective dissemination of microfiche

(d) 1498 Output Reports

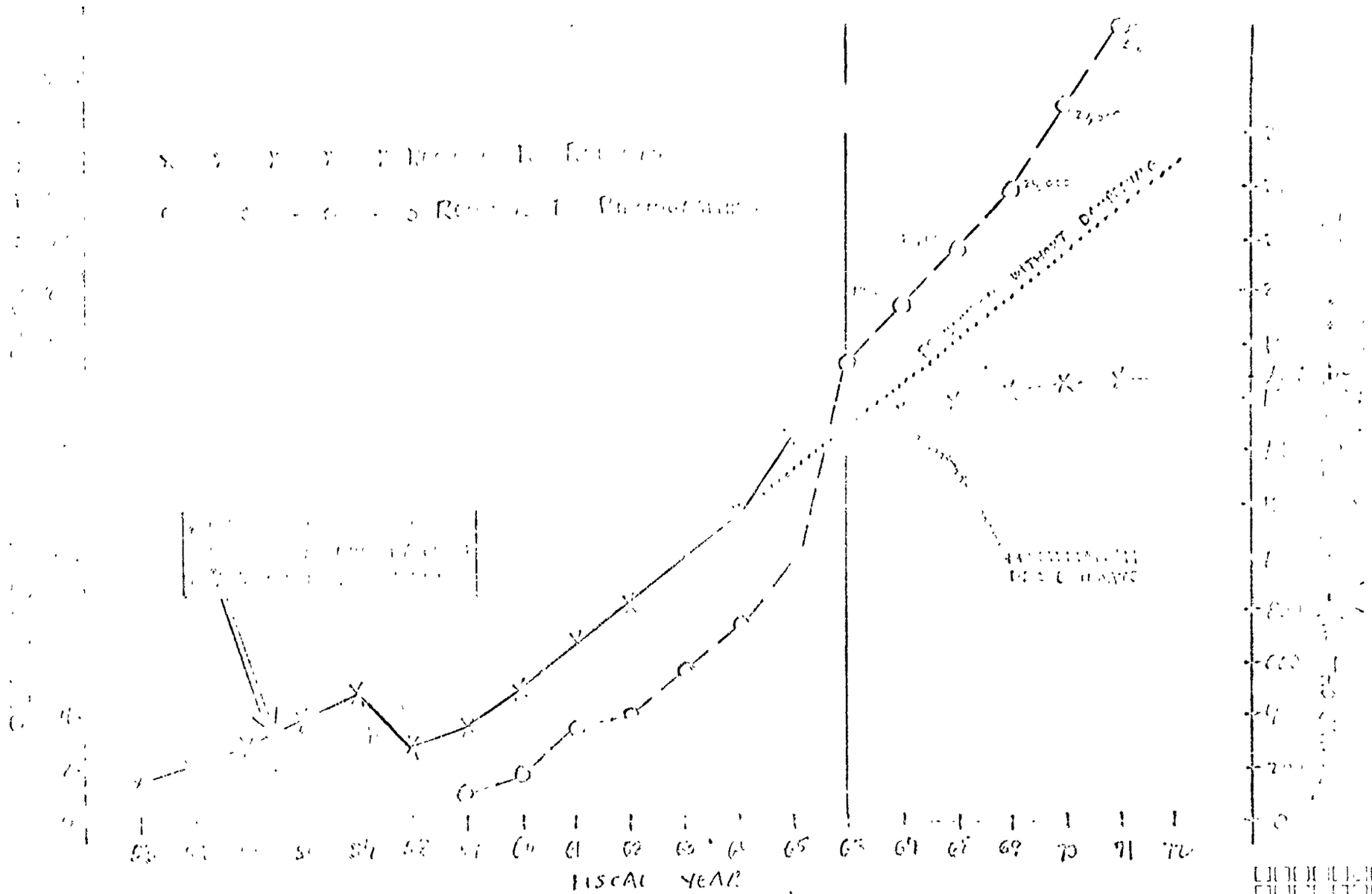
(e) Microform master production activity

Unless otherwise noted, all of the following figures pertain only to DDC and not to the combined loads of DDC and CFSTI.

3.6.2.1 Requirements for reports and bibliographies

The "Projected Requests for Reports and Bibliographies" is shown as Figure F-3. This figure also shows the history of request activity which formed the primary basis of the projection. The history curve of requests for reports includes DDC plus CFSTI and the 10 percent of requests which will not be filled. This curve shows a straight-line increase from FY 1959 through FY 1966, except for FY 1965 which was somewhat greater than the rise in request activity during the eight-year period. If this rise were to continue without any dampening effect for the next five years, the request activity would amount to 2.4 million requests per year.

It is believed, however, that a dampening effect, and subsequent leveling off, will take place as a direct result of SDI of microfiche. The DDC estimate (shown plotted on the figure) indicates a severe cutback of report requests as a result of SDI of micro-



PROJECTED REQUESTS FOR REPORTS & BIBLIOGRAPHIES

Figure F- 3

fiche, leveling off to 1.0 million per year in FY 1971. This implies nearly 60 percent decrease in demand as a result of SDI of microfiche. It is felt that the effect will not be this dramatic. Instead, a rapid dampening effect upon the steep rise during the preceding 8 years is expected to occur. This dampening would result in a leveling off of request demand and probably a drop - but will likely occur slightly beyond the five-year period.

As a result of this effect of SDI of microfiche, it is anticipated that the requests for documents will go from 1.5 million in FY 1966 to 1.65 million in FY 1971. The standard 5 percent per year growth rule-of-thumb would call for about 1.9 million requests per year by FY 1971. For the same reasons given above, it is believed that even this rate of request growth will be dampened; the more conservative figure of 1.65 million requests in FY 1971 was selected as probably being closer to reality.

Also shown on Figure F-3 is the projection of requests for bibliographies. It can be expected that bibliography requests will continue rising rather steeply at about 10 to 15 percent per year for a period well beyond the five-year projection. This being the case, the current rate of 17,500 bibliographies in FY 1966 will amount to 24,000 in FY 1969 and 30,000 in FY 1971. At an average of 137 computer-generated pages per bibliography, the page requirements will jump from 2.4 million in FY 1966 to 4.1 million in FY 1971. This demand will have a significant impact upon computer output requirements in FY 1971, as well as before that time.

3.6.2.2 Copy request fulfillment curves

As a result of the determination of total requests for reports, discussed immediately above, it is possible to determine DDC's portion of this workload. These figures are shown on the botton line of Table F-6, "Projected Copy Request Fulfillment Activity". As projected, the 677,000 requests for documents filled in FY 1966 will slowly rise to 831,000 in FY 1971.

The copy requests were fulfilled in FY 1966 by one of five methods:

(a) Original hard-copy (from shelf stock)

(b) Multilith reproduction (from copyflo mats made from roll microfilm)

(c) Hard-copy blowback from 35mm microfilm (copyflo)

(d) Microfiche blowback

(e) Microform (Microfiche)

An analysis of the fulfillment activity indicated that the hard-copies shipped were distributed among the five methods by the following percentages: 34, 19.8, 33.6, 6 and 6.6 percent, respectively. Then, projecting the examination to the FY 1971 time frame, an analysis was made as to the most desirable direction and probable degree of change of each of these percentages. The next step was to determine the logical shape of the curves between the FY 1966 percentages and the projected percentages. With this information it was possible to determine the number of hard-copies to be produced by each of the five methods for the next five years.

The results of this analysis are shown on Table F-4 and are plotted individually on Figure F-4, "Projected Copy Request Fulfillment Curves", Figure F-4 also shows the projected "number of documents shipped" curve. The only comment necessary relating to Table F-4 is that the number of documents is a more significant measure of change than are percentages. This is due to the effect of the increasing number of documents requested. There is, however, much that could be said about Figure F-4 relating to the interactions of the various curves. The major considerations are discussed in the following paragraphs.

The multilith curve is rising at a relatively rapid rate partly because of the continuously increasing number of documents. However, this rise is primarily a result of the expectation that more effective statistical forecasting methods will be implemented in the next few years to anticipate demand so that pre-stocking via multilith will place the desired copies on the shelf prior to the request. This direction is not only economical from the standpoint of decreased duplication costs, but it would also decrease the time required to fill requests. The rate of multilith utilization will undoubtedly taper off as maximization of the pre-stocking principle is approached. Multilith utility will also increase as a result of the relaxation of the rule prohibiting pre-stocking of any material prior to a given date. It is believed that an arbitrary cut-off date for shelf stocking is not as effective a stockroom maximization technique as pre-stocking relatively high-demand old documents.

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PROJECTED COPY [illegible] REQUIREMENT [illegible]

FY —		66	67	68	69	70	71
SINGLE COPY DUPLICATION (HARDCOPY)	TOTAL	268,421 39.6%	272,0[illegible] 37%	268,[illegible] 34%	249,000 31%	221,500 27%	192,000 22%
	COPYFLO BLOWBACK	227,839 33.6%	213,0[illegible] 29%	196,000 24%	[illegible] 18%	98,500 12%	42,000 5%
	MICRO-FILMED, [illegible]	40,582 6%	59,000 8%	77,500 10%	96,000 12%	123,000 15%	150,000 18%
MULTILITH (HARDCOPY)		133,457 19.8%	185,000 24.5%	229,500 29.5%	274,000 34%	320,000 39%	331,000 40%
ORIGINAL (HARDCOPY)		250,275 34%	228,000 31%	217,000 28%	202,000 25%	180,000 22%	166,000 20%
MICROFORM (MICROFICHE)		44,871 6.6%	53,000 7.2%	66,000 8.5%	80,000 10%	98,000 12%	141,[illegible] 17%
TOTAL DOCUMENTS		677,000	735,000	778,[illegible]	[illegible]	[illegible]	[illegible]

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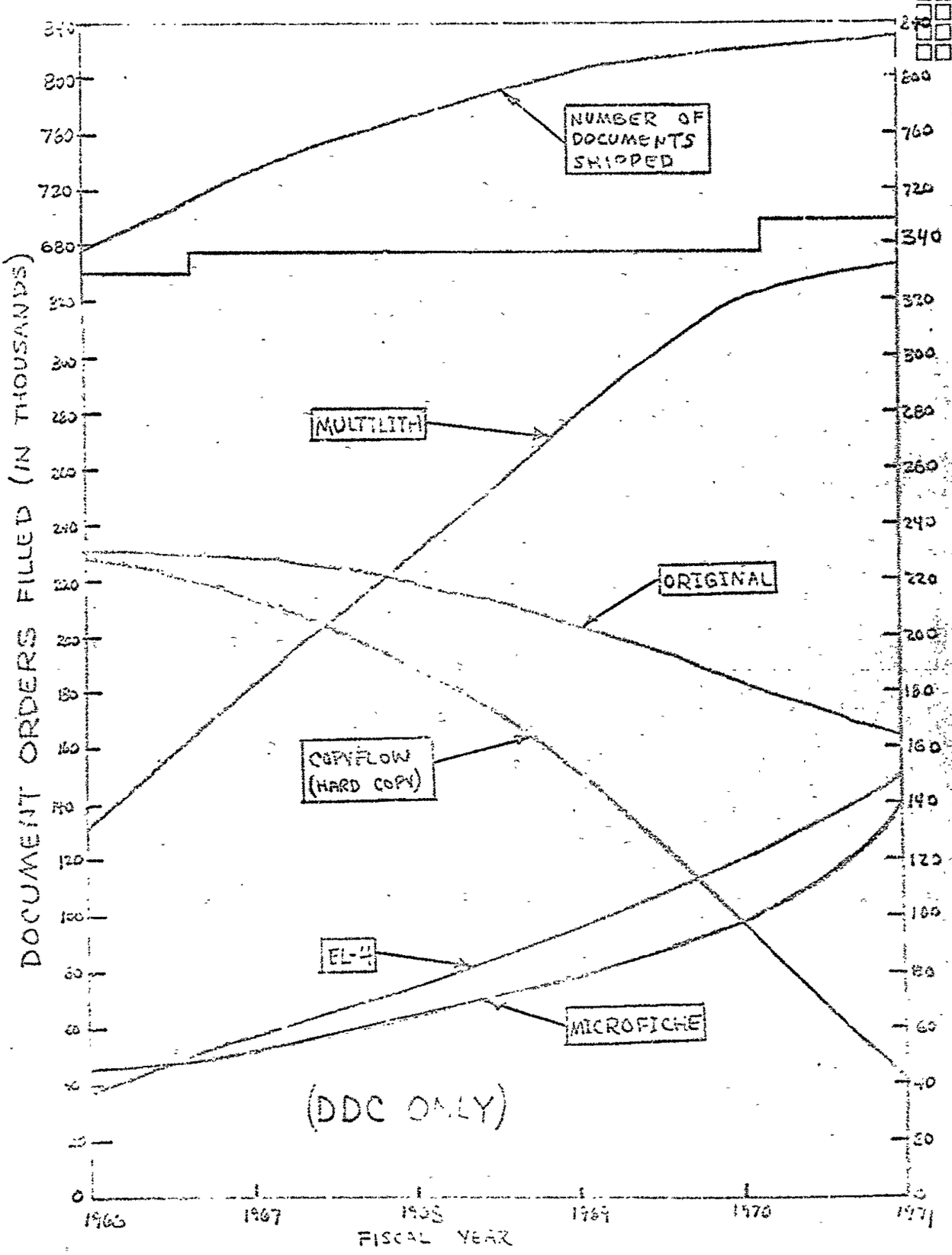


PROJECTED COPY REQUEST FULFILLMENT CURVES

FIGURE F-4

Xerox Copyflo hard-copy blowback will probably decrease for two reasons. First of all, employing the increased utility of multilith in anticipation of requests will sharply reduce the need for low-volume production (especially one at a time) on the Copyflo. Secondly, as the older documents currently on roll film become older, the demand for copies will tend toward zero. Eventually, the need for the Copyflo for hard-copy blowback may disappear. Also, if a better method for preparing mats becomes available, there would no longer be a need for the Copyflo.

It is believed that the number of original hard-copy documents taken from the shelf to fill requests will be reduced significantly. On the surface, it appears that this tendency is objectionable. However, the entire approach to maximization of stockroom efficiency is one of trade-offs; in this way, and only in this way, can the overall (total) cost be minimized. A big price in shelf space inefficiency is being paid by stocking the original 20 copies of low-demand reports. The trade-off is as follows:

(a) Low-demand copies should be removed from the shelf.

(b) Requests for low-demand copies would then be supplied by microfiche blowback.

(c) The shelf space made available would be utilized by multilithed hard-copies of higher demand documents.

(d) The overall effect would be lower operating costs, more efficient utilization of shelf space, and reduced request servicing time.

Microfiche blowback to hard-copy production via the EL-4 will logically increase during the next five years for two reasons. The total volume of documents shipped will be increasing as a result of higher demand for single blowback copies for low-demand documents removed from the shelves.

There is a projected rise in microfiche as the requested media for document receipt. It is logical that as more microfiche equipment becomes available the popularity of documents on microfiche will correspondingly increase. The rise will likely not be significant during the five-year projected period but should start a rather steep ascent during the last year.

As stated earlier, the shapes of these curver are a result of trade-offs and will, therefore, be sensitive to the decisions of DDC management. The ultimate objective of maximizing the effectiveness of document storage and request servicing will be achieved only from a complete analysis of all the characteristics of request activity and the application of tested and proven techniques for accomplishing this objective.

3.6.2.3 Selective dissemination of microfiche

The "Projected Selected Dissemination of Microfiche" at DDC is shown in Figure F-5. It has been constructed by considering each of its three constituent elements and then summing the annual requirements across the top. The three elements and broad basis of the projections are as follows.

3.6.2.3.1 SDI to repositories

DDC field offices and other large users with across-the-board need-to-know will automatically receive on microfiche 95 percent of the expected annual input of documents. The number of recipients has been calculated at 30 in FY 1968 and 60 in FY 1971. Assuming 1.8 microfiche per document, the curve in Figure F-5 was plotted; it shows the microfiche required for this purpose increasing from 635,000 in FY 1966 to 4.2 million in FY 1971. It is expected that the steep curve shown in the figure will level off sharply after 1971-1972. It is interesting to note that the DDC five-year plan expects only 0.75 million microfiche for repositories by FY 1971.

3.6.3.3.2 SDI by subject sets

Automatic distribution of microfiche by subject sets is expected to grow to at least 500 users by FY 1968 and then taper off to about 850 users by FY 1971. Assuming 2500 documents per year (covers only classified and unclassified/limited) to each recipient, the requirement for microfiche in this category will grow from about 1.0 million in FY 1966 to 3.8 million in FY 1971.

3.6.2.3.3 RFP packages

In response to requests from procurement offices, DDC will begin distributing microfiche packages

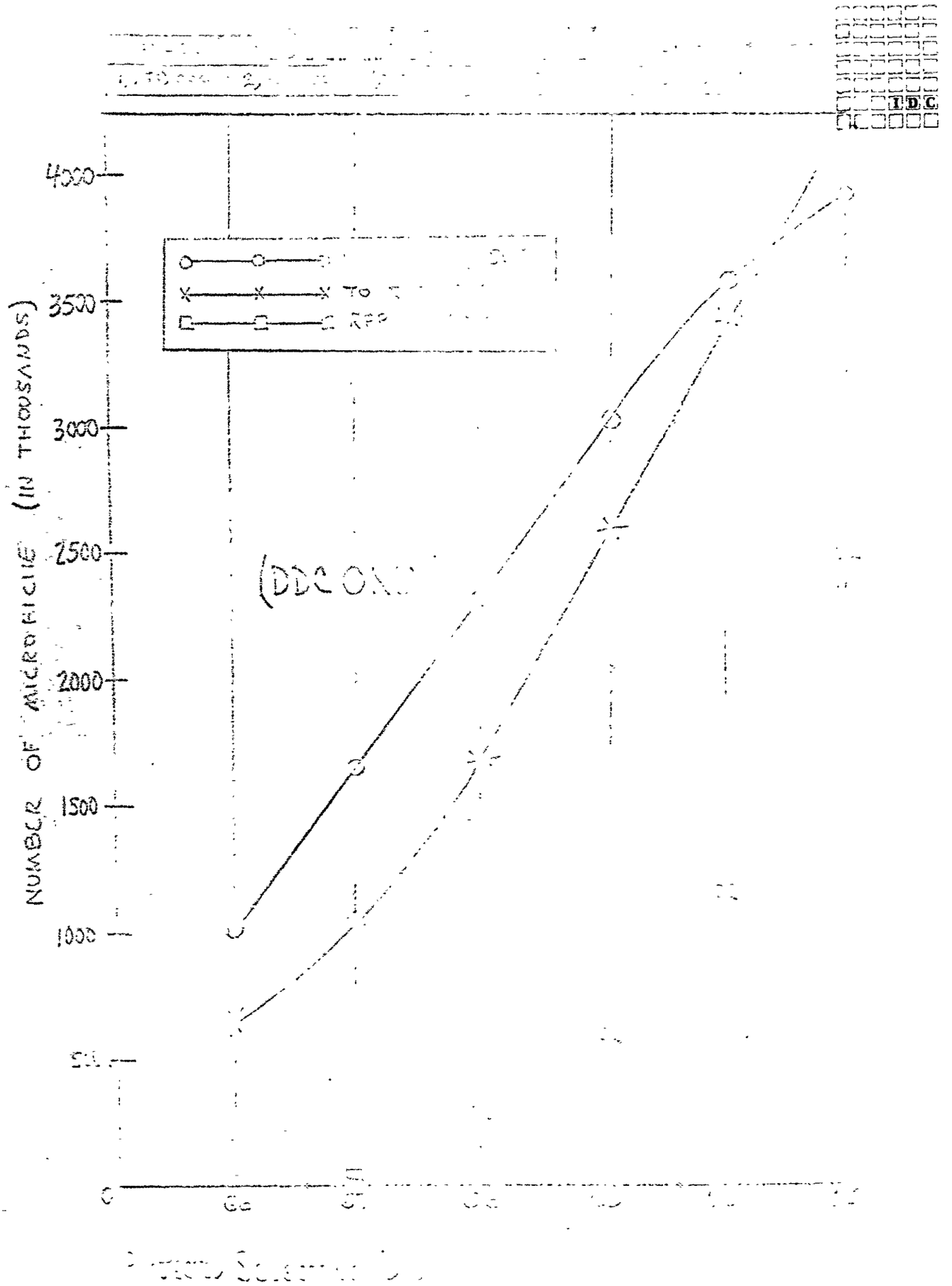

NUMBER OF MICROFICHE (IN THOUSANDS)
4000
3500
3000
2500
2000
1500
1000
500
0
TO
RPP
(DDC ONL

FIGURE F-5

to prospective contractors in FY 1967. It is expected that the microfiche requirements for this proposal will grow quite rapidly. However, it is believed that the majority of the packages will be of an unclassified nature, thereby having less of an impact on DDC than on CFSTI. In spite of this, it is anticipated that microfiche requirements for RFP packages at DDC will amount to 300,000 in FY 1968, over 1.0 million by FY 1970, and about 2.5 million by FY 1971. This volume is expected to increase at this rate for several years beyond the five-year period.

3.6.2.4 1498 output reports

The 1498 data bank, containing RDT&E work unit data, is a management information service of major significance. Figure F-6, "Projection of 1498 Output Reports", compares the DDC five-year projection (from the five-year plan) with the IDC five-year projection. It is believed that both projections are on the conservative side. However, it is felt that the exponentially rising curve, exhibited by the IDC projection, is more representative of the expected rise in demand for such management services. Not included on this projection is the possible mechanization and provision of computer-generated CPE and CCR reports. Both of these management information systems will have more impact upon the computer complex than on micrographics at DDC.

3.6.2.5 Microform master production activity

The projection of microform master production is an important factor in planning for micrographic equipment and microform storage requirements. Figure F-7, "Projected Microform Master Production Activity", shows the five-year projections for document input, microfiche masters and roll film masters. The basis for these projections is the 14-year history of titles announced in TAB (DDC Summary Management Data Report, June 1966, page 15). Statistically projecting this data gave the forecast for the next five years. As indicated by the same reference (page 14), 63 percent of this input entered the DDC collection. The result of this exercise is the "Document input" line on Figure F-7. The number of microfiche is 1.8 times the number of documents; this established the projection of microfiche masters as shown.

The projection of roll-film master production was determined as a combination of requirements for roll film in the preparation of multilith mats and the requirements for roll film

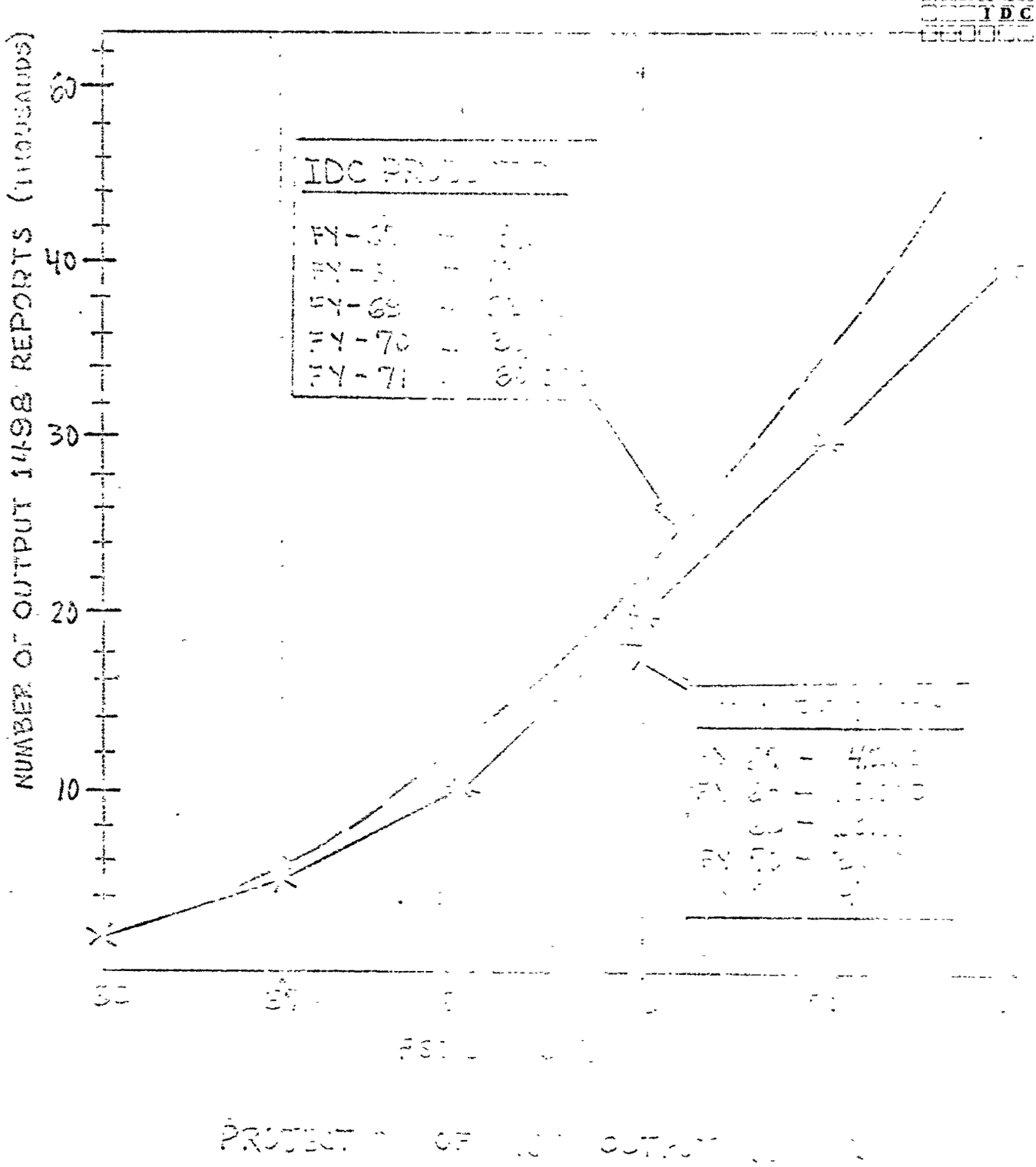


FIGURE F-6

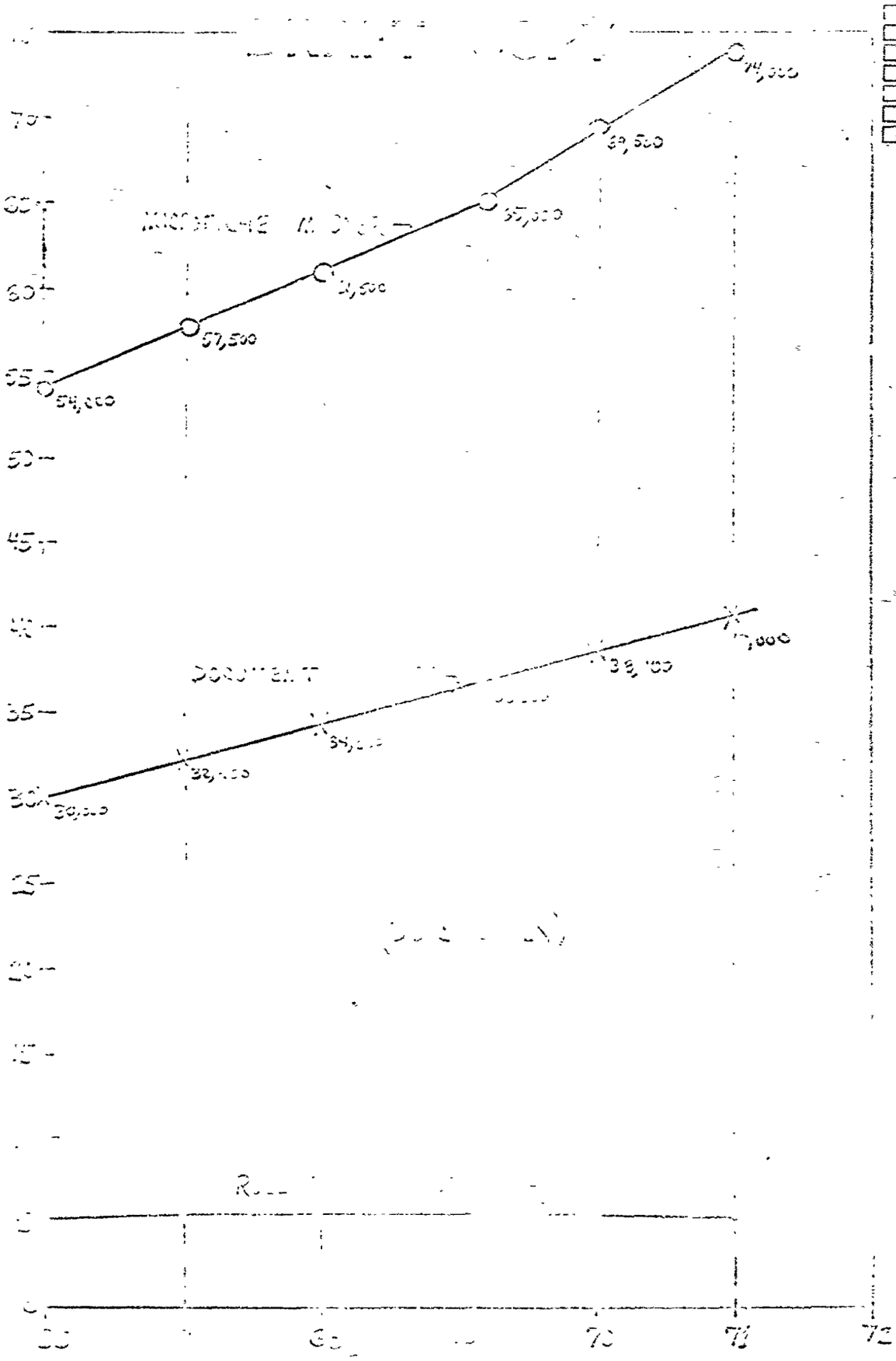

70
65
60
55
50
45
40
35
30
25
20
15
54,000
57,500
61,500
65,000
69,500
74,000
30,000
32,000
34,000
38,000
40,000
70
72

FIGURE 2-7

in automatic filming of new documents having less than three copies received by DDC. Various counterbalancing forces have stabilized this figure at approximately 5,000 per year.

3.6.3 Developmental actions

The indicated development actions related to Plan Zero and the developments related to integrated process control are both described in Table F-3. The descriptions in this figure are in terms of individual developmental actions, the schedule for these actions and the annual manpower and budgetary requirements for the next five years.

4. DISCUSSION OF ALTERNATIVE ACTION PLANS

The synthesis of all of the developmental actions related to each plan are described in Table F-3. The individual plans, Plan Zero, Plan 1, Plan 2, Plan 3 and Plan 4 can be identified by their constituent development actions. Each development action is described as an individual line item in a format and in terms familiar to DDC management. The action plans can be completely described in terms of the schedule plan, manpower and dollar requirements for each year in the next five year period.

Table F-3, in its present draft form, merely lists the developmental actions without details as to the scheduling, manpower and costing data. These figures have been developed and are currently being examined and carefully analyzed prior to their inclusion in the final report on August 22, 1966.

There are over 30 individual developmental actions identified on Table F-3. Obviously, not all of these actions apply to each of the service concepts. The developmental actions are listed under each applicable service concept for ease of reference. For this reason, some of the developmental actions appear numerous times. The service concepts that appear are only those that have pertinency to the microfiche problem. Fifteen service concepts have been listed-- seven current services and eight projected service system concepts.

TABLE F-3 -- DRAFT COPY

1	A-1	Advanced development system design for automatic microfiche storage and retrieval device enabling implementation tests in next item.
2	A-2	Develop procedures for use and pilot test of automatic microfiche file and retrieval device for handling increased traffic flow in film library.
3	A-3	Advanced development study of production techniques for mat production from microfiche enabling pilot implementation tests in next item.
4	A-4	Develop procedures for use and pilot test of step-and-repeat device for production of multilith mats from microfiche.
5	A-5	Study request pattern on all demand services including hard copy and microfiche to enable future prediction of requests for specific documents.
6	A-6	Advanced development study of relationships between original inventory, pre-stocked inventory and single copy blowback to optimize internal production flow, storage space and delivery time.
7	A-7	Advanced development study of the flow relationships between primary and secondary distribution to determine degree of overlap at user organizations.
14	A-8	Develop improved production process flow and work place design to minimize microfiche handling and decrease out-of-file time.
17	A-9	Develop computer program to organize and schedule file and retrieval operations associated with hard-copy blowback from microfiche.
20	A-10	Advanced development study of relationship between primary distribution of microfiche and secondary distribution of hard copy to enable prediction of future workloads.
21	A-1[illegible]	Develop training program for operation and maintenance of step-and-repeat device for mat production from microfiche.
[illegible]7	A-[illegible]	Develop [illegible] program to predict impact of microfi[illegible] and retrieval machine down-[illegible] on hard [illegible]duction.
[illegible]	A-[illegible]	Adv[illegible] system design for automatic [illegible] and retrieval device enabling [illegible]

TABLE F-3 -- DRAFT COPY

2	B-2	Develop procedures for use and pilot test of automatic microfiche file and retrieval device for handling increased traffic in film library.
5	B-3	Study request pattern on all demand services including hard copy and microfiche to enable prediction of future demand for specific microfiche.
6	B-4	Advanced development study of relationship between original inventory, pre-stocked inventory and single microcopy to optimize internal production flow, storage space and delivery time.
7	B-5	Advanced development study of flow relationships between primary and secondary distribution of microfiche to determine overlap at user organizations.
8	B-6	Develop procedures for use and pilot test of automatic camera malfunction detection device.
8	B-7	Develop procedures for use and pilot test of camera exposure programming device for automatic insertion of AD numbered targets, resolution targets and microfiche numbers.
10	B-8	Develop specifications and pilot test procedures for device for enclosing microfiche in protective envelope.
11	B-9	Develop specifications and pilot test procedures for automatic film inspection device for detecting frame overlaps, film fogging and low background contrast.
12	B-10	Develop method for updating microfiche by marking, imprinting or other technique.
13	B-11	Develop methods for wrapping, packaging and labeling microfiche shipments.
14	B-12	Develop improved production process flow and work space design at camera operator, film processing and microcopy stations.
15	B-13	Develop perpetual inventory system which automatically generates low level warning and restock instructions based on record of use.
16	B-14	Develop computer program for detecting low level use and generating destruction instructions for low use microfiche copies in stock.
17	B-15	Develop computer program to organize and schedule [illegible] camera operator, film processing and [illegible]

TABLE F-3 -- DRAFT COPY

18	B-16	Develop computer program to predict raw stock consumption and automatically issue stock orders.
19	B-17	Advanced development study to devise methods for predicting need for second shift operation or additional equipment.
20	B-18	Advanced study of relationship between primary and secondary distribution to determine future demands for microcopy.
21	B-19	Develop training program for operation and maintenance of new equipment for microfilming, film processing and inspection, and microcopy production.
22	B-20	Develop techniques and/or equipment for adding, deleting or changing single master microfiche frames.
29	B-21	Investigate effect of magnetic tape distribution on microfiche orders.
37	B-22	Develop computer program to predict impact of machine down-time in microfilming, film processing and microcopy operations.
42	B-23	Develop methods for collating, grouping and sorting microfiche.
46	B-24	Develop improved forms and techniques for flow control and improved forms for reporting production statistics.
47	B-25	Advanced development study of user request motivations to predict future demand volume.
48	B-26	Develop improved classified control procedures for upgrading, downgrading and re-classifying microfiche masters and copies.
52	B-27	Advanced development study of effect of research-in-progress (from work unit data bank information) on request traffic patterns.
5	E-1	Advanced development study of effect of demand bibliographies on microcopy orders.
[illegible]	E-2	Advanced development study to determine acceptability of distributing on-demand bibliographies in microform.
[illegible]	[illegible]-1	Advanced development study of effect of work unit data bank bibliographies on microcopy orders.
[illegible]	[illegible]-2	Advanced development study of effect of research-in-[illegible] (from work unit data bank information) [illegible]

TABLE F-3 -- DRAFT COPY

1	G-1	Advanced development system design for automatic microfiche storage and retrieval device enabling implementation of next item.
2	G-2	Develop procedures for use and pilot test of automatic microfiche file and retrieval device for handling increased traffic in film library.
5	G-3	Advanced development study to predict selection of specific items for selective dissemination.
17	G-4	Advanced development study of relationship between primary and secondary distribution to assess overlap at user organizations.
14	G-5	Develop improved production process flow and work place design at microcopy operation.
17	G-6	Develop computer program to organize and schedule microcopy workload.
18	G-7	Develop computer program to predict consumption of raw stock and automatically create stock orders.
19	G-8	Advanced development study to devise method of predicting need for second shift operation or added equipment.
20	G-9	Advanced development study of relationship between primary and secondary distribution to predict future microcopy demand.
21	G-10	Develop training program for operation and maintenance of new microcopy equipment.
25	G-11	Develop methods for producing duplicate sets of selected microfiche and for maintaining quality of intermediate microfiche masters.
26	G-12	Develop search strategy for selecting documents for automatic distribution on microfiche.
27	G-13	Develop computer program to detect patterns of selection to minimize total number of microfiche dissemination patterns.
7	G-14	Develop computer program to predict impact of machine down-time on microcopy operations.
2	G-15	Develop [illegible]-blade-knife microfiche chopper to maintain uniform microfiche length in cutting from roll film.
	G-16	Develop [illegible] splicer for 105 mm microfilm.

TABLE F-3 -- DRAFT COPY

41	G-17	Develop computer program to create and maintain automatic distribution list for microfiche.
42	G-18	Develop methods for collating, grouping and sorting microfiche.
44	G-19	Advanced development study to analyze document order patterns for creating selective dissemination of microfiche profiles.
45	G-20	Develop computer program for updating document selection search patterns for microfiche distribution.
46	G-21	Develop forms and procedures for processing profiles for dissemination of microfiche and for controlling microfiche shipments.
48	G-22	Develop classified control procedures.
51	G-23	Develop file maintenance and utility routines associated with selective dissemination of microfiche ADP files.
29	H-1	Advanced development study of effect of magnetic tape distribution on microfiche copy orders and relationship between internally conducted user SDI programs and the DDC dissemination of microfiche program.
5	J-1	Advanced development study of request patterns at field services to enable future demand prediction on specific documents and to detect regional document order patterns.
10	J-2	Develop procedures for use and pilot test of automatic device for enclosing microfiche in protective envelopes.
11	J-3	Develop procedures for use and pilot test of automatic film inspection device.
12	J-4	Develop methods of updating microfiche by marking, imprinting or other technique.
13	J-5	Develop methods for wrapping, packaging and labeling of microfiche shipments.
13	J-6	Develop computer program for detecting low use rate documents for future phase out at field services and extension services.
14	J-7	Develop computer program to predict raw stock consumption at field services and to automatically create stock orders.

TABLE F-3 -- DRAFT COPY

19	J-8	Develop computer program to predict need for additional reader/printers and microcopy equipment at field services.
20	J-9	Advanced development study of relationship between primary and secondary distribution and field service operations on hard-copy and microcopy orders.
21	J-10	Develop training program for operation and maintenance of new equipment installed at field services.
22	J-11	Develop techniques for adding, deleting or changing single microfiche copies at field services.
38	J-12	Develop double knife fiche cutter for maintaining uniform microfiche length.
42	J-13	Develop method for collating, grouping and sorting microfiche shipments to field services.
48	J-14	Develop classified control procedures for field service microfiche shipments.
18	N1-1	Develop computer program to predict raw stock consumption and automatically generate stock reorders.
21	N1-2	Develop training program for operation and maintenance of roll film microcopy equipment with automatic roll film cartridge inserter modification.
32	N1-3	Investigate feasibility of using Stromberg-Carlson ~~4020~~ 4400 magnetic tape to microfilm converter.
33	N1-4	Develop procedures for use and pilot test of automatic microfilm cartridge inserter attachment to microcopy unit.
35	N1-5	Develop specifications and pilot test for reader/printer for cartridge in capsulated roll film and microfiche.
36	N1-6	Develop computer program for formatting TAB index data on microfilm (for conversion from magnetic tape to microfilm on Stromberg-Carlson 4020).
37	N1-7	Develop methods and investigate materials for roll microfilm cartridge labeling.
5	N1-8	Design tab-on-microfilm order forms.
1	N1-9	Develop computer file maintenance and utility routines for MIP files associated with tab-on-microfilm service concept.

TABLE F-3 -- DRAFT COPY

1	N2-1	Advanced development system design for automatic microfiche storage and retrieval device enabling implementation tests in the following item.
2	N2-2	Develop procedures for use and pilot test of automatic microfiche file and retrieval device for handling increased traffic in film library.
5	N2-3	Advanced development study of factors leading to methods for predicting selection of specific items.
17	N2-4	Advanced development study of relationship between primary distribution of state-of-the-art microfiche sets and secondary distribution of microfiche to determine relationships useful for predicting workload.
10	N2-5	Develop procedures for use and pilot test of device for enclosing microfiche in protective envelopes.
11	N2-6	Develop procedures for use and pilot test of device for inspecting microfilm copies.
13	N2-7	Develop methods for wrapping, packaging and labeling of microfiche shipments.
18	N2-8	Develop computer program for predicting consumption of raw stock and for automatically generating stock reorders.
19	N2-9	Develop computer program to predict need for second shift operation or additional equipment.
20	N2-10	Advanced development study to determine the effect of state-of-the-art microfiche sets on hard-copy orders.
21	N2-11	Develop training programs for operation and maintenance of new equipment and implementing new procedures.
25	N2-12	Develop techniques for producing duplicate sets of selected microfiche and for maintaining intermediate microfiche masters.
26	N2-1	Develop search strategy for microfiche selection for inclusion in state-of-the-art packages.
27	N2-1	Develop computer program for detecting bibliographic request patterns leading to identification of likely candidates for state-of-the-art microfiche package assembly.

TABLE F-3 -- DRAFT COPY

37	N2-13	Advanced development of computer program to predict impact of machine down-time on microcopy production.
38	N2-16	Develop double knife microfiche chopper for maintaining uniform microfiche lengths.
39	N2-17	Develop heat splicer for 105 mm microfilm.
40	N2-18	Develop computer program to create and maintain subject and other indexes to subsets of microfiche.
41	N2-19	Develop computer program to provide and maintain distribution list for microfiche.
42	N2-20	Develop methods for collating, grouping and sorting microfiche.
43	N2-21	Develop methods for updating subsets of microfiche by addition, removal or replacement of items.
45	N2-22	Develop methods for updating search patterns for selecting additions to microfiche subset.
46	N2-23	Design forms for requesting and controlling state-of-the-art microfiche packages.
47	N2-24	Examine request motivation to detect patterns useful for predicting future demands.
48	N2-25	Develop classified control procedures.
51	N2-26	Develop computer programs for file maintenance and utility routines associated with state-of-the-art microfiche service concept.
1	N3-1	Advanced development system design for automatic microfiche storage and retrieval device enabling implementation tests in the following item.
2	N3-2	Develop procedures for use and pilot test of automatic microfiche file and retrieval device for handling increased traffic in film library.
3	N3-3	Advanced development study to determine effect of project-oriented microfiche sets on hard-copy demand.
7	N3-4	Advanced development study to determine relationship between primary and secondary distribution to detect overlap at user organizations.
[illegible]	N3-5	Develop procedures for use and pilot test of device for enclosing microfiche in protective envelopes.

TABLE F-3 -- DRAFT COPY

11	N3-6	Develop procedures for use and pilot test of device for automatic film inspection of microfiche copies.
13	N3-7	Develop methods for wrapping, packaging and labeling of microfiche shipments.
18	N3-8	Develop computer program for predicting consumption of raw stock and for automatically issuing reorders.
19	N3-9	Develop computer program to predict need for second shift operation or additional equipment.
20	N3-10	Advanced development study to determine relationship between primary distribution of project-oriented microfiche sets and on-demand secondary distribution of microfiche.
21	N3-11	Develop training program for operation and maintenance of new equipment.
22	N3-12	Develop techniques for adding, deleting, or changing single master microfiche frames.
25	N3-13	Develop techniques for producing duplicate sets of selected microfiche and methods for maintaining intermediate microfiche masters.
26	N3-14	Develop search strategy for selecting microfiche for inclusion in project-oriented microfiche sets.
27	N3-15	Develop computer program to detect selection patterns to derive optimum number of dissemination patterns.
37	N3-16	Advanced development study to predict impact of machine down-time on production of project-oriented microfiche sets.
38	N3-17	Develop double knife microfiche chopper for maintaining uniform microfiche lengths.
39	N3-18	Develop heat splicer for 105 mm microfilm.
41	N3-19	Develop computer program to create and maintain distribution lists of project-oriented microfiche sets.
[illegible]	N3-[illegible]	Develop methods for collating, grouping and sorting microfiche.
[illegible]	N3-21	Develop methods for updating project-oriented microfiche sets.

G. IMPACT OF DEVELOPMENT ACTION PLANS

1. INTRODUCTION

In Section F.3.6 the evolution of "Plan Zero" has been described. This plan involves the continuation of all present services, but not the inclusion of any new services, even those which have already been contemplated by DDC. Based on this set of services, and a projection of loads on the DDC production system due to increasing demand, a set of development actions is deduced. These are the things that should be done "just to stay in business."

Earlier the point was made (Section F.2) that there were many advantages to be derived from undertaking a restructuring of the process operations, placing them under centralized automatic control. To generate "Plan Zero" the integrated process control (IPC) system development is added to the present services.

In this section the discussion of impact of the various action plans, Zero, 1, 2, 3, and 4, is discussed at two levels. The first level is composed of overall impact on DDC and the user communities which it serves. The second level is the more detailed level of detailed impact on DDC operations.

2. GENERAL IMPACT OF PLANS

2.1 Impact on DDC of Introducing Integrated Process Control

This subject is discussed separately with regard to DDC only, for this is the area of direct impact, although the ability to operate more effectively has, of course, a secondary effect on all segments of the user community.

The introduction of IPC into DDC has implications in all aspects of DDC operations, as well as the image that DDC creates in the eyes of the user community. These are brought out in Figure G-1 and are discussed below.

2.1.1 Production management

The process system suggested, which places control under a central computer system, can take its control signals directly from the "line", maintain all production statistics, and provide almost immediate data necessary to the management of production. Overloads can be anticipated and allowed for, and resource allocations can be made.

DDC
INTEGRATED PROCESS
CONTROL

Production Management	Administrative Management
Productivity	Response to New Requirements
Quality of Products	Initiation of New Services
Speed of Service	Posture in DOD System
Posture in User Community	Posture in Federal System

Areas of Impact Consequent to Evolution to an Automated Integrated Process Control System in DDC

FIGURE G - 1

2.1.2 Productivity

Although a production operation such as that required by DDC is not a continuous flow process, it can be treated in somewhat the same manner. The main requirement is that batch processes be avoided, and that uniform mechanical handling techniques be introduced wherever possible. The result of such "continuous" flow is the removal of much of the accumulated delay throughout the process. There is little time lost due to "waiting in line", and a consequent increase in productivity.

2.1.3 Quality of products

The improvement in quality of products that is usually seen to result from this sort of production operation, is rather a secondary effect. The requirement to so standardize procedures and material qualities so that the system can run at all, usually means a more uniform and higher quality of product. Another possible benefit arises from the ability to narrow the scope of operations for an individual so that he may become more adept with less training than would otherwise be required.

2.1.4 Speed of service

This goes hand-in-hand with increased productivity, but there is still another aspect. The centralized control capability means that job programming may be done automatically. Special requests that lead to certain production requirements can be scheduled with a minimum of delay.

2.1.5 Posture in user community

The better the quality of service, in any respect whatsoever, that can be offered, the greater the significance of DDC in the eyes of the users and the greater the reliance on the services offered.

2.1.6 Administrative management

The greater the extent to which centralized computer control of production can be achieved, the easier the overall management. The computer can provide practically all the necessary data in real-time which permits management to react as rapidly as possible.

2.1.7 Response to new requirements and initiation of new services

With EPC in a completed fact, implementation of new production requirements or of new services becomes much easier.

2.1.8 Posture in DOD and Federal systems

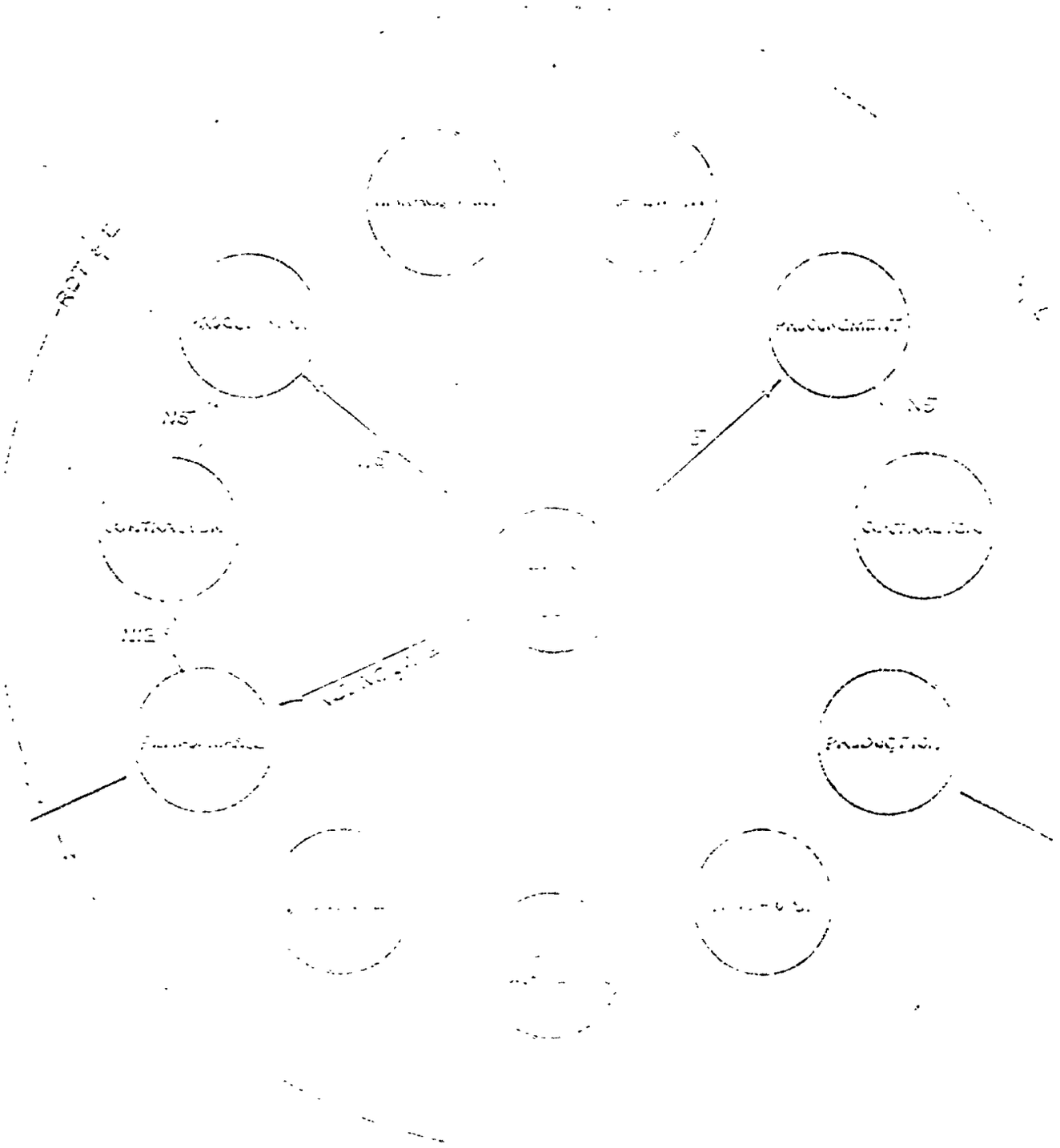
EPC will permit DDC to assume a strong position in any integration of emerging information systems, both inside DOD and in establishing interfaces with other Federal systems. There are active programs of great scope going on elsewhere in DOD, such as EDIS, with which integration will be necessary. Agencies other than DOD are also moving toward very large systems. An interface requirement exists now and will become a reality. Having a smooth production operation in embedded, designed along efficient lines, will enable the integration to take place smoothly.

2.2 Impact on the DDC User Community

2.2.1 Phase 1

Phase 1 consists of DDC present services, to which are added those services N 3, N 6 and N 12. The general areas of impact are shown in Figure C-1. The DDC user community is shown as broken into four parts or functions: Management, Procurement, Contractors, and DDC Performance. The DDC community is shown (in very much aggregate form, as consisting also of four parts: Management, Procurement, Contractors, and Production. The non-DOD community is represented as Federal, U.S. Non-Federal, and Non-U.S. Direct impacts are shown as being directed at the appropriate part of the user community. Some services, however, will affect the interaction between the parts of the community and DDC.

Service [illegible] contemplates furnishing [illegible] to submit technical reports to prospective bidders [illegible] procurement process. It is [illegible] as emerging [illegible] function in both the [illegible] communities. The effects are felt on the contractors also, for it tends to place potential bidders on a more equal footing in the competition, thus [illegible] quality of proposal, and leads ultimately, from the point of view of the [illegible] procurement offices, to higher influence on successful procurements. This service would also tend



MAJOR AREAS OF IMPACT OF PLANT
ON THE USER COMMUNITIES
Figure C-2

to stimulate more competition for procurements and this too can lead to better work.

N 5 is also shown as impinging directly on the performance of RDT&E, which would be true because much backup information is thereby immediately available to the successful bidder. The corresponding arrow to the production aspect of I&L is not present, for that kind of information does not apply to manufacturing.

Service concept N 6 would furnish research-in-progress data to the scientific and technical community so that information on where certain kinds of technical work is going on would be available. This would make possible the cross-fertilization of projects which now may proceed in mutual ignorance. The effects are felt directly on the level of performance of research and development.

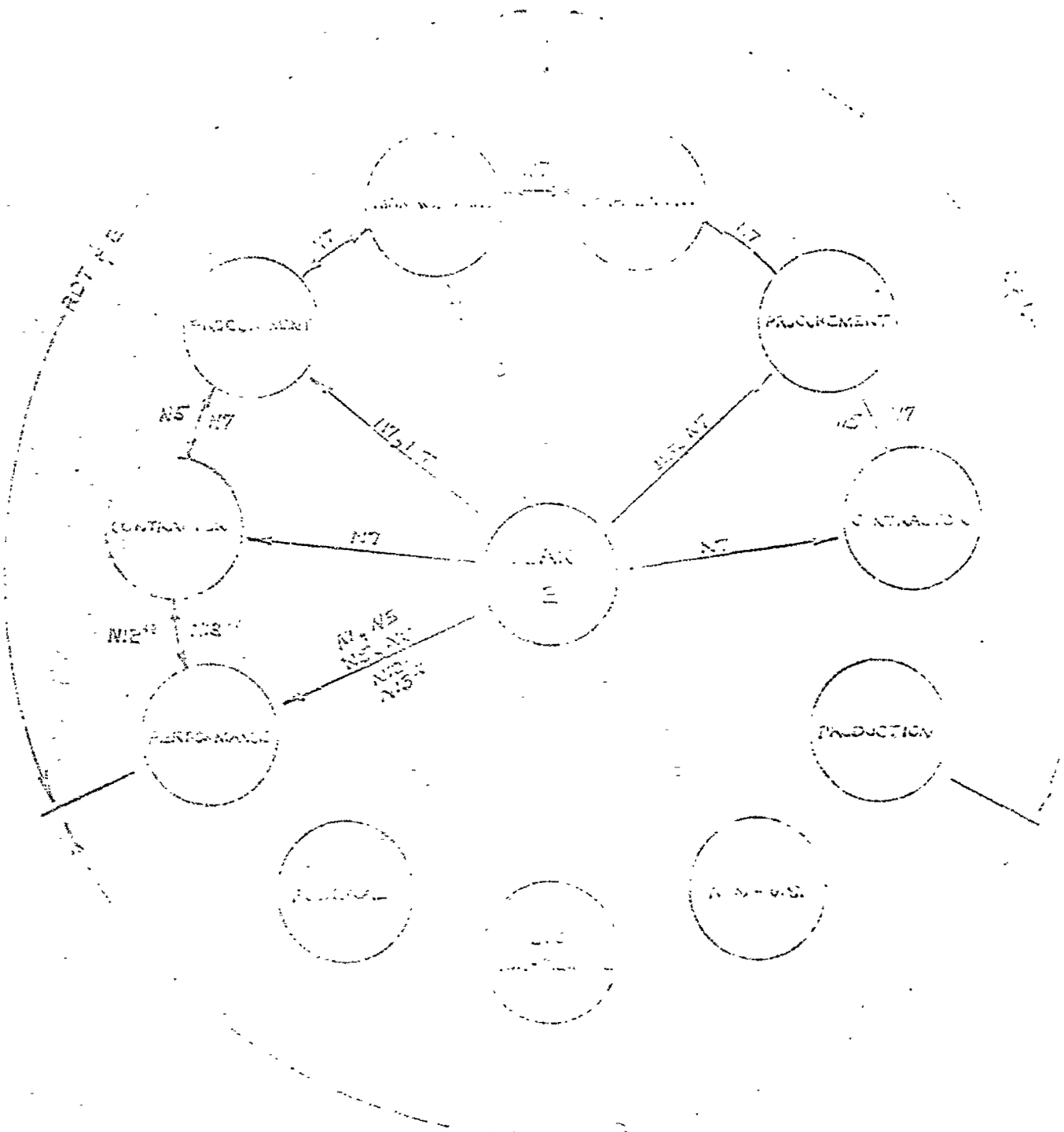
Concept N 12 is exploratory in nature, and proposes the investigation of the problem of maintaining bibliographic access to all sorts of technical information other than reports. This would impact most heavily on the quality of performance of RDT&E. The engineering function would be well served if such service were available, and the contractor performance quality could be expected to improve.

2.2.2 Plan 2

Plan 2 consists of all that has been described for Plan 1, plus the addition of Services N 1, N 3, N 7, and N 13. Figure G-8 shows the cumulative of impact produced thereby.

Service N 1, distribution of TAB on microfilm, should tend to assist, to a degree, the RDT&E operations at the project level. It is of no value from the management side, and the assistance at project level is not too high. Certainly the accumulation of large hard-copy libraries is avoided, and more rapid access to older TAB's is achieved. The overall impact, however, is felt to be low.

Service N 3 deals with supplying task-oriented sets on-demand in microfiche form. As presently envisaged, the major impact is on the RDT&E community at the project level. Data contained on the 1498 form is used to construct the search for the initial package, and the package can be maintained on a current basis on DDC's initiative. The impact is high on the project worker level.



MAJOR AREAS OF IMPACT ON PLAN 2
ON THE USER COMMUNITY
Figure G-3

Service N 7 directs itself primarily at the procurement function in both communities, as well as at the contractor level. Secondary impacts are felt on management and between the management levels of both the RDT&E and I&L communities. The service would have several reactions. The procurement offices could have hard-copy indexes of all companies in their areas of interest. They could also request specialized packages of resume materials or could query the system for uniquely qualified suppliers.

The contractor group benefits as well. It would no longer be necessary to furnish qualifications data to numerous individual procurement offices, and for various procurement actions. Furthermore, they could be assured that their qualifications were placed in the file of any given office.

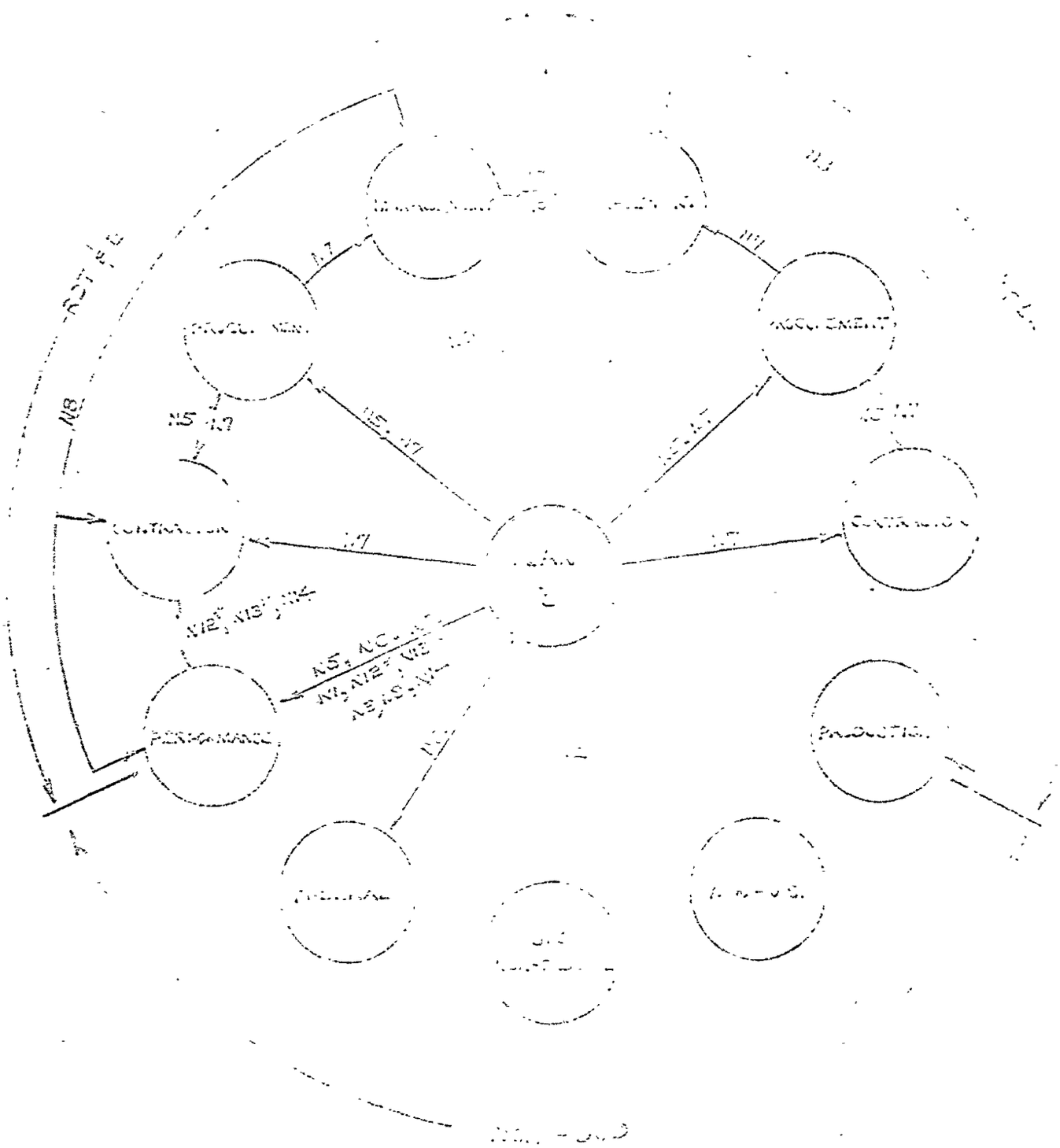
Service N 18 deals with the problem of distribution of a wide variety of materials other than technical reports. This, if achieved, would be a tremendous resource to the engineering community. It would impact heavily on the quality of performance of RDT&E.

2.2.3 Plan 3

To the concepts of Plan 2 are added the services N2, N8, N9, and N 10. The areas of impact are shown in Figure G-4.

Service concept N 2 would provide a great service to the performance of RDT&E through the supply of state-of-the-art review packages in microfiche form. These could be maintained on a current basis, and could be supplied also to other Government agencies and, if unclassified, to the civilian community through CFSTI. A major impact to the RDT&E community rests in the assurance that the latest information on a given subject is available, and this can help to steepen the time-consuming learning curves.

The automation of the data bank for CPE and CCR (Service N 8) would significantly improve the services now being rendered. The impact rests directly on management in both the RDT&E and I&L communities, with an interaction back on production or performance, as the case may be. The impact is high, but offers only a present service in a better way.



MAJOR AREAS OF IMPACT OF PLAN 2
ON THE USER COMMUNITIES
Figure C-4

Service N 9 proposes to study methods of truncating technical reports so that less than the full report, but more than the abstract, is available to the scientist. This will enable him to determine whether he wants or needs to obtain the full report. If this procedure is feasible, the impact upon the user, i.e., those conducting R&D at the project level, could be high in terms of time saved.

In N 14 it is proposed to merge the primary and secondary distribution control for technical reports. The idea is extended to offer eventual production support as well as distribution to contractors. Higher quality and more uniform products would be an anticipated result, with reduction in delays in secondary distribution.

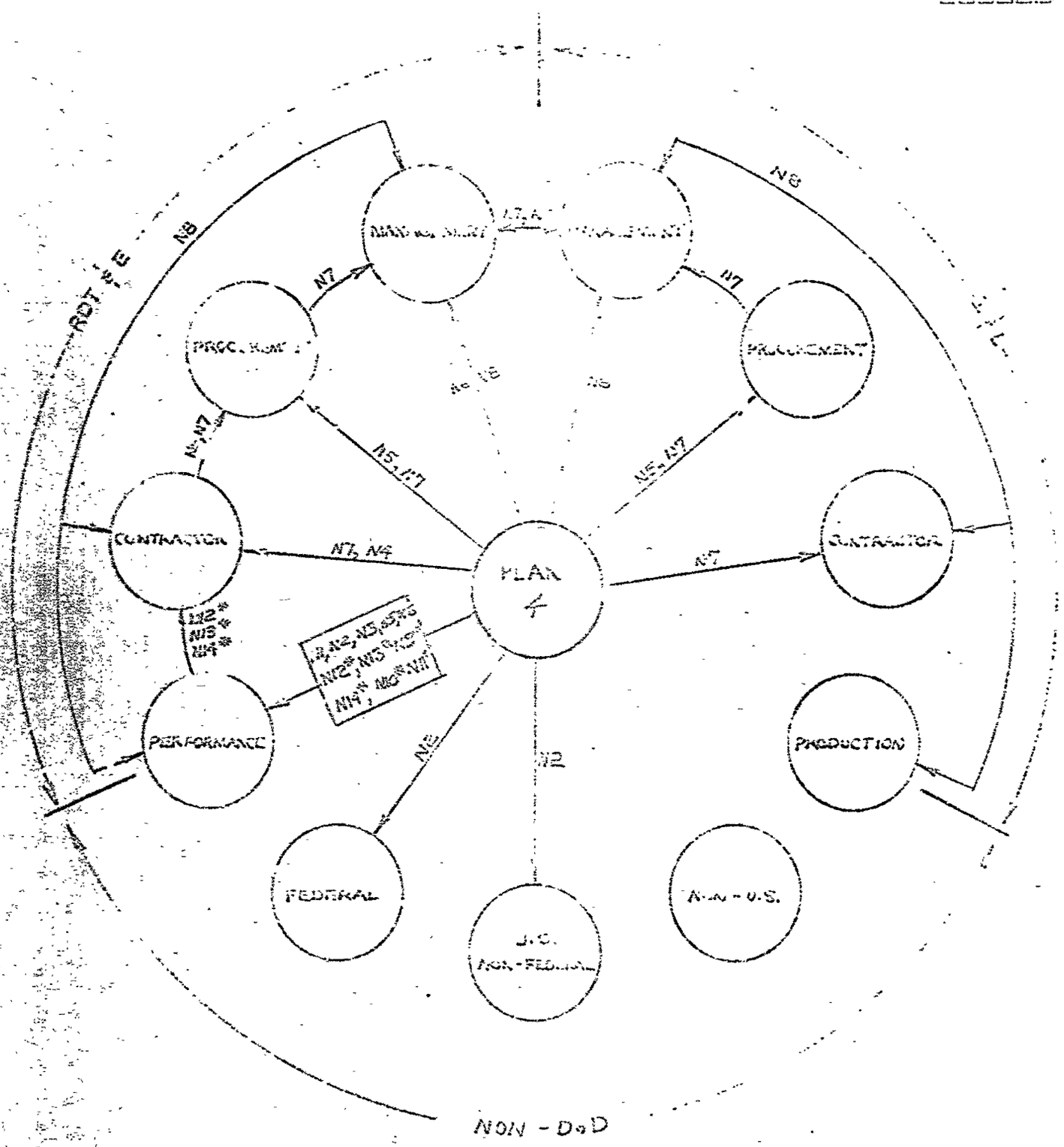
2.2.4 Plan 4

Plan 4 adds to those discussed above, the service concepts N 4, N 10, and N 11. The impact areas are shown in Figure G-5.

Service N 4 relates to the source production of microfiche of technical reports. It impinges directly on the RDT&E contractor in a rather large way. The contractor produces the microfiche master which is transmitted to DDC where the document is reproduced and distributed. The necessity of sending 20 hard copies is eliminated.

Services N 10 and N 11 represent further concepts to reduce the volume of hard-copy that must be distributed. N 10 proposes to segment technical reports during microfiche production so that any desired portion (according to a pre-designed format) could be obtained, rather than the entire document. The specificati of a proper format, and imposing its use on the authors of technical reports promises to be difficult indeed. Certainly new policies and user education would be required, and initially the impact could be expected to be large and negative.

The segmentation of indexes and announcement journals, as suggested in N 11. While feasible, it is not considered a high pay-off option, and should not be initiated without careful study. In both N 10 and N 11 the impact on the users, namely the contractors performing RDT&E is probably small.



MAJOR AREAS OF IMPACT OF PLAN 4
ON THE USER COMMUNITY
Figure G-5

3. IMPACT OF ACTION PLANS ON DDC

The service concepts and the various development activities have been fully described above. Following is a brief statement of the impact of these development activities upon DDC:

3.1 No. 1 - Automatic Microfiche File Retrieval Device

Minimize or reduce the expansion of manpower otherwise needed to maintain and operate a film library.

3.2 No. 4 - Device to Produce Multilith Mat from Microfiche

Urgently needed to fill current needs to enable lithographic mats to be made from microfiche. As microfiche replaces 35 mm roll film the need will become greater. Such a device will eliminate need for double filming of documents.

3.3 No. 5 - Study of Request Patterns

Prediction of traffic, transport time, allowable lags and peak loads to operate an automated file system.

3.4 No. 6 - Study Relationship Between Pre-stock, Inventory and One-shot Copying

Will reduce number of one-shot copies of either microfiche or hard copy.

3.5 No. 7 - Study Relationship Between Primary and Secondary Distribution

Basis for deciding if primary distribution control would cut down on repetitive requests.

3.6 No. 8 - Automatic Camera Malfunction Detection Device

Will save some finite percentage (as much as 10 percent) of bulk supply film cost and needless processing of rejects.

3.7 No. 9 - Camera Exposure Programming Device

Will increase productivity by reducing errors at source of production input minimizing need for further manpower as production increases.

3.8 No. 10 - Microfiche Envelope Inserter

Will reduce, and make feasible, manpower requirements for material handling with respect to anticipated volume of work flow.

3.9 No. 11 - Automatic Film Inspection Device

Will assure image quality and registration accuracy of large volumes (produced or received) of microfiche without excessive manual workload.

3.10 No. 12 - Method of Updating Microfiche by Marking

Will eliminate subsequent edition and revision of codes for security classifications and limitations.

3.11 No. 13 - Wrapping, Packaging and Labeling of Shipments

Will make material handling volume feasible in light of large volume of distribution.

3.12 No. 14 - Improved Production Process Flow in Workplace Design

This task is essential to accomplish the integrated process control system design as it relates to the micrographic production area.

3.13 No. 15 - Perpetual Inventory with Automatic Generation of Pre-Stock Instructions

This serves as central inventory checkpoint necessary to maintain inventory during request activity eliminating need to refer to physical shelf location before identifying need to take inventory replenishment action.

3.14 No. 17 - Develop Program to Organize and Schedule Workload

This is part of the overall plant-wide, integrated process control system as it applies to production control in the micrographic area.

3.15 No. 18 - Develop Program to Predict Raw Stock Consumption and Create Stock Replenishment Orders

Necessary as an internal integrated process control routine for issuing work orders.

3.16 No. 19 - Develop Program to Predict the Need for Second Shift or Added Equipment

Same as above.

3.17 No. 20 - Study Relationship Between Primary and Secondary Distribution and Implications to DDC

Results of this study might change the mixture between primary and secondary distribution modes.

3.18 No. 21 - Develop Training Program for Operation and Maintenance of Equipment

Necessary for efficient operation of new equipment and development of new procedures.

3.19 No. 22 - Develop Technique for Adding, Deleting or Changing a Single Frame in a Master Microfiche

This development is necessary before the reduction in wasted film and reduction in time necessary to remake microfiche masters in adding addenda or making minor revisions.

3.20 No. 23 - Study Acceptability of Distributing On-Demand Bibliographies on Microfilm and Study Attendant Production Problems

This task is necessary in anticipation of reducing demand bibliography production by high-speed printout on microfilm.

3.21 No. 25 - Study Techniques for Producing Duplicate Sets of Microfiche for an Intermediate Master Maintenance

Techniques developed will reduce manual labor required for multiple duplication of sets of microfiche.

3.22 No. 26 - Develop Search Strategy for Selecting Microfiche Sets

Impact will be to provide the major users with sets of microfiche and to thereby reduce demand for secondary distribution of hard copy.

3.23 No. 27 - Program to Detect Patterns of Selection to Derive Optimum Number of Patterns

This will reduce the total number of search patterns used for guiding selection and distribution of task-oriented sets of microfiche. Impact is to anticipate increased volume of orders for hard copy and microfiche which examples to date indicate may be severe.

3.24 No. 28 - Program to Measure Impact of SDI of Microfiche on Demand Orders for Microfiche to Predict Ultimate Volume of Secondary Distribution of Microfiche from Points Currently Receiving Microfiche on Automatic Distribution.

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